Missile Defense Agency
Ballistic Missile Defense System (BMDS)

Programmatic Environmental Impact Statement

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FINAL BMDS PEIS

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DEPARTMENT OF DEFENSE

Office of the Secretary

Record of Decision to Develop, Test, Deploy, and Plan for Decommissioning of the Ballistic Missile Defense System

AGENCY: Missile Defense Agency, Department of Defense

ACTION: Notice

I. SUMMARY: The Missile Defense Agency (MDA) is issuing this Record of Decision (ROD) to develop, test, deploy, and plan for decommissioning of the Ballistic Missile Defense System (BMDS). This decision includes the development, testing, deployment, and planning for decommissioning of land-, sea- and air-based platforms for BMDS weapons components and space-based sensors. This action will enable MDA to develop and field an integrated, layered, BMDS to defend the United States (U.S.), its deployed forces, allies, and friends against all ranges of enemy ballistic missiles in all phases of flight. The BMDS is a key component of U.S. policy for addressing ballistic missile threats worldwide.

II. FOR FURTHER INFORMATION CONTACT: For further information on the BMDS Programmatic Environmental Impact Statement (PEIS) or this ROD please contact Mr. Rick Lehner, MDA Director of Public Affairs at (703) 697-8997. Downloadable electronic versions of the Final PEIS and ROD are available on the MDA public access Internet web site http://www.mda.mil/mdalink/html/enviro.html. Public reading copies of the Final PEIS and the ROD are available for review at the following public libraries:

- Anchorage Municipal Library (Anchorage, AK)
- Mountain View Branch Library (Anchorage, AK)
- California State Library (Sacramento, CA)
- Sacramento Public Library (Sacramento, CA)
- Hawaii State Library (Honolulu, HI)
- University of Hawaii at Manoa (Honolulu, HI)
- Arlington County Public Library, Central Branch (Arlington, VA)
- District of Columbia Public Library, Central Branch (Washington, DC)

III. SUPPLEMENTAL INFORMATION:

A. MDA Decision

The MDA is issuing this ROD, selecting Alternative 1 as described in the BMDS PEIS, to develop, test, deploy, and plan for decommissioning of the BMDS. This decision includes the development, testing, deployment, and planning for decommissioning of land-, sea-, and air-based platforms for BMDS weapons components. Alternative 1 also includes space-based sensors. MDA is deferring a decision on the development, testing, and deployment of space-based interceptors (Alternative 2) pending further concept development and policy discussion.

B. Background

The MDA has a requirement to develop, test, deploy, and prepare for decommissioning the BMDS to protect the U.S., its deployed forces, friends, and allies from ballistic missile threats. The proposed action would provide an integrated BMDS using existing infrastructure and capabilities, when feasible, as well as emerging and new technologies, to meet current and evolving threats in support of the MDA's mission. Consequently, the BMDS would be a layered system of defensive weapons, sensors, command and control, battle management, and communications (C2BMC), and support assets, each with specific functional capabilities, working together to defend against all classes and ranges of ballistic missile threats in all phases of flight. Multiple defensive weapons would be used to create a layered defense comprised of multiple intercept opportunities along the trajectory of the incoming ballistic missiles. This would provide a layered defensive system of capabilities designed to back up one another.

On December 17, 2002, the President announced his decision to field an initial defensive operation capability. The initial fielding would provide a modest protection of the U.S. and would be improved over time. Prior to the initiation of the BMDS PEIS, MDA and its predecessor agencies prepared several programmatic National Environmental Policy Act (NEPA) documents regarding ballistic missile defense. In addition, each program element prepared extensive NEPA documentation to cover its own specific test and development activities. Ballistic missile defense has evolved to the point that the BMDS PEIS was prepared to consider the integrated BMDS as envisioned in the evolution of the MDA.

A Programmatic EIS, or PEIS, analyzes the broad envelope of environmental consequences in a wide-ranging Federal program like the BMDS. A PEIS addresses the overall issues in a proposed program and considers related actions together in order to review the program comprehensively. A PEIS is appropriate for projects that are broad in scope, are implemented in phases, and are widely dispersed geographically. A PEIS

creates a comprehensive, global analytical framework that supports subsequent analysis of specific activities at specific locations, which could then be tiered from the PEIS.

The BMDS PEIS is intended to serve as a tiering document for subsequent specific BMDS NEPA analyses and includes a roadmap for considering environmental impacts and resource areas in developing future documents. This roadmap identifies how a specific resource area can be analyzed and also includes thresholds for considering the significance of environmental impacts to specific resource areas. This means that ranges, installations, and facilities at which specific BMDS activities may occur in the future could tier their documents from the PEIS and have some reference point from which to start their site-specific analyses.

C. National Environmental Policy Act (NEPA) Process

The MDA prepared the BMDS PEIS pursuant to the Council on Environmental Quality (CEQ) regulations implementing the NEPA (40 CFR Parts 1500-1508); Department of Defense (DoD) Instruction 4715.9, *Environmental Planning and Analysis*; the applicable service environmental regulations that implement these laws and regulations; and Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions* (whose implementation is guided by NEPA and the CEQ implementing regulations).

On April 11, 2003, MDA initiated the public scoping process by publishing the Notice of Intent (NOI) to prepare the PEIS for the BMDS in the Federal Register. MDA held public scoping meetings in Arlington, Virginia; Sacramento, California; Anchorage, Alaska; and Honolulu, Hawaii. The Notice of Availability (NOA) of the MDA BMDS Draft PEIS was published in the Federal Register on September 17, 2004. This initiated a public review and comment period for the Draft PEIS. MDA held public hearings in Arlington, Virginia; Sacramento, California; Anchorage, Alaska; and Honolulu, Hawaii. MDA received approximately 8,500 comments on the Draft PEIS; MDA considered all of these comments in preparing the Final PEIS. Responses to all of the in-scope comments can be found in Appendix K of the PEIS. Three recurring issues of public concern—orbital debris, perchlorate, and radar impacts to wildlife—were addressed in more technical detail in Appendices L, M, and N, respectively, of the PEIS.

The NOA for the Final PEIS was published in the Federal Register on February 16, 2007. This ROD is the culmination of the NEPA process.

D. Alternatives Considered

In developing the alternatives, MDA reviewed the various components of the BMDS (i.e., weapons, sensors, C2BMC, and support assets) and the acquisition process common to all components (i.e., development, testing, deployment, and planning for decommissioning). The components are the systems and subsystems of logically grouped hardware and software that perform interrelated tasks to provide the BMDS functional capabilities. The acquisition process is capability-driven and component-based. Capability-based planning allows MDA to develop capabilities and system performance objectives based on technological feasibility, engineering analyses, and the potential capability of the threat. Spiral development is an iterative process for developing the BMDS by refining program objectives as technology becomes available through research and testing with continuous feedback among MDA, the test community, and the military operators. Each new technology goes through development; promising technologies go through testing and demonstration; and proven technologies are incorporated into the BMDS.

- **Development**. Development includes the various activities that support research and development of the BMDS components and overall systems. This includes planning, budgeting, research and development, systems engineering, site preparation and construction, repair, maintenance and sustainment, manufacture of test articles and initial testing, including modeling, simulation, and tabletop exercises.

- **Testing**. Testing of the BMDS involves demonstration of BMDS elements and components through test and evaluation. The successful demonstration of the BMDS would rely on a robust testing program aimed at producing credible system characterization, verification, and assessment data. To confirm these capabilities, MDA would continue to develop test beds using existing and new land-, sea-, air-, and space-based assets. Some construction at various geographic locations would be required to support infrastructure and assets where BMDS components and the overall system would be tested. Testing of the BMDS includes ongoing and planned tests (e.g., ground tests, flight tests) of components that might be incorporated into the BMDS, as well as tests of the layered, integrated BMDS through increasingly realistic system integration tests through 2012 and beyond.

- **Deployment**. Deployment of the BMDS refers to the fielding (including the manufacture, site preparation, construction, and transport of systems) and sustainment (including operations and maintenance, training, upgrades, and service life extension) of the BMDS. The evolving BMDS is intended to have the capability over time to deploy different combinations of interoperable components. Deployment also would involve the transfer of facilities, elements, and programs to the military services.

- **Decommissioning**. Decommissioning would involve the demilitarization and final removal and disposal of the BMDS components and assets. Plans would be made for decommissioning BMDS components by either demolition or transfer to other uses or owners.

The following presents a discussion of the alternatives considered by MDA and presents and contrasts the components and acquisition phases that are unique to each alternative.

No Action Alternative: Under the No Action Alternative, the MDA would not develop, test, deploy, or plan for decommissioning activities for an integrated BMDS. Instead, the MDA would continue existing development and testing of discrete systems as stand-alone ballistic missile defense capabilities. Individual systems would continue to be tested but would not be subjected to System Integration Tests.

Alternative 1 (selected alternative): Under Alternative 1, the MDA will develop, test, deploy, and plan to decommission an integrated BMDS, composed of land-, sea-, and air-based components. Alternative 1 also includes space-based sensors, but does not include space-based interceptors.

Alternative 2: Under Alternative 2, the MDA would develop, test, deploy, and plan to decommission an integrated BMDS, composed of land-, sea-, air-, and space-based components. Alternative 2 would be identical to Alternative 1, with the addition of space-based interceptors. A space-based test bed would be considered and evaluated to determine the feasibility of using kinetic energy interceptors on space platforms to intercept threat missiles.

E. Environmental Impacts of Alternatives

The PEIS evaluated potential impacts associated with each alternative for each acquisition life cycle phase (i.e., development, testing, deployment, and planning for decommissioning) by component (i.e., weapons, sensors, C2BMC, and support assets). To evaluate the potential impacts of implementing one of the alternatives (i.e., No Action Alternative, Alternative 1, or Alternative 2) considered for the BMDS, the MDA characterized the existing condition of the affected environment in the locations where various BMDS implementation activities would occur. The affected environment includes all land, air, water, and atmospheric environments where proposed activities are reasonably foreseeable. For this PEIS, the affected environment includes all locations, ranges, installations, and facilities that the MDA has used, uses, or proposes to use for the BMDS both within and outside the U.S. The MDA determined that activities associated with the proposed BMDS might occur in locations around the world. Therefore, the affected environment has been considered in terms of global biomes, broad ocean areas, and the atmosphere.

Each biome covers a broad region, both geographically and ecologically for both domestic and international locations where components of the proposed BMDS may be located or operated. Climate, geography, geology, and distribution and abundance of vegetation and wildlife determine the range of the biomes. Using biomes as affected environmental designations facilitates future site-specific environmental documentation to tier from the BMDS PEIS. Further, BMDS test activities would often occur over broad ocean areas, and the necessity of launching targets and interceptors to support testing would indicate that consideration of the atmosphere and broad ocean areas as parts of the affected environment was appropriate.

To evaluate the potential environmental consequences of the alternatives, the components of the BMDS (i.e., weapons, sensors, C2BMC, and support assets) were evaluated as they proceed through acquisition life cycle phases. MDA evaluated each of the BMDS acquisition phases including development, testing, deployment, and decommissioning. Not all activities associated with the BMDS are expected to produce environmental impacts. Only those activities with expected impacts during one or more acquisition phases were identified in the PEIS. Further, only those activities that are considered reasonably foreseeable were analyzed in the PEIS. Four steps were used to analyze impacts in the BMDS PEIS. Step 1 included the identification and characterization of BMDS activities. Step 2 included the identification of activities with no potential for impact. Step 3 included the identification of similar activities occurring across acquisition life cycle phases. Step 4 included the conduct of environmental analyses. The analyses for each alternative are specific to each resource area based on the impacts from the activities associated with the BMDS components.

The potential impacts of the various alternatives are summarized in Exhibits ES-7 through ES-13 in the Final BMDS PEIS (available on the MDA web site http://www.mda.mil/mdalink/html/enviro.html and are as discussed in the Final BMDS PEIS. This ROD presents a brief discussion that highlights the differences between the alternatives.

Alternative 1 would result in the potential for increased environmental consequences over the No Action Alternative due to the additional integrated test events and the development and testing of an integrated C2BMC. The additional potential for environmental consequences associated with the development, testing, deployment, and planning for decommissioning of the space-based interceptors in Alternative 2 could result in environmental consequences that would be in addition to those associated with Alternative 1.

The increase in potential impacts associated with the development and acquisition phases of Alternatives 1 and 2 over the No Action Alternative would result from increased testing and the site preparation and development of new facilities or the refurbishment of existing facilities for C2BMC, or to develop space-based missile defense technologies.

The site preparation may result in additional impacts on the land-based resources (i.e., biological, geology and soils, noise, water), but would not impact non-land based resources (i.e., airspace or orbital debris).

The increase in potential impacts associated with the testing acquisition phase of Alternatives 1 and 2 over the No Action Alternative would result from an increased number of test events, specifically, system integration tests. The increase in the number of test events would result in additional impacts on all resource areas, and based on the specific activities and objectives of an individual test event, impacts on some resources might be insignificant as demonstrated in the PEIS, while impacts to other resources would be more substantial.

The increase in potential impacts associated with the deployment acquisition phase of Alternative 2 over Alternative 1 and the No Action Alternative would result from the site preparation, development, and emplacement of new facilities or the refurbishment of existing facilities for deployment of space-based interceptors. The site preparation may result in additional impacts on the land-based resources (e.g., biological, geology and soils, noise, water), and placing interceptors into space could produce impacts on non-land based resources (e.g., airspace or orbital debris).

The increase in potential impacts associated with the planning for decommissioning of Alternative 2 over Alternative 1 and the No Action Alternative would result from the additional BMDS components that would require decommissioning.

No significant environmental impacts or cumulative impacts on resource areas addressed for any activity considered in implementing the BMDS were found in this programmatic impact analysis. There could be impacts associated with the specific BMDS program activities at specific locations; however, as stated in the PEIS they would be addressed, as appropriate, in subsequent NEPA analyses that would tier from the PEIS. As appropriate, mitigation measures would be developed to address any site-specific significant impacts.

F. Mitigation Monitoring

MDA did not identify any significant programmatic environmental impacts arising from the proposed action and therefore, is not identifying specific mitigation measures. However, as discussed above, there is the potential for specific BMDS activities at specific locations to impact the environment, and mitigation measures would be identified, as appropriate, in future NEPA analyses tiered from this PEIS. MDA uses a mitigation monitoring database to track the implementation of mitigation measures identified in previous NEPA analyses and will continue to follow its mitigation monitoring process (Environmental Management Plan-3-62, Mitigation Monitoring) to both track and monitor the effectiveness of MDA's mitigation measures, including those identified in future, site-specific NEPA analyses tiered from this PEIS.

G. Environmentally Preferred Alternative

The findings of the PEIS indicate that the No Action Alternative, the continuation of existing program element-based testing and development activities with no integration testing, would be the environmentally-preferred alternative. As a conservative estimate, MDA assumed that stand-alone element component testing as well as system integration testing would occur under Alternatives 1 and 2, which would result in potentially more adverse effects than the No Action Alternative. However, MDA believes that consolidation of stand-alone component tests associated with Alternative 1 into the system integration tests to the extent practicable could serve to reduce the overall environmental consequences as the total number of tests conducted by MDA could fall.

H. Conclusion

I have considered potential environmental impacts as defined in the PEIS, cost, technical requirements, applicable statutory and regulatory requirements, Presidential direction (the December 17, 2002, Presidential announcement to field an initial defensive operation capability), MDA's mandate and mission, and public comments in arriving at my decision.

I select Alternative 1 over the other alternatives for implementation of the proposed action. Although the No Action Alternative has been identified as the environmentally-preferred alternative, it does not support the Agency's mandate or mission. Alternative 1 has fewer environmental consequences than Alternative 2, as described above.

I have selected Alternative 1 because integration of missile defense capabilities as opposed to single element development, testing, and deployment is essential to an effective BMDS that can provide a layered defense of the United States, its deployed troops, and its friends and allies. Any decision to deploy a BMDS capability will be subject to Presidential and Congressional authorization and funding.

Signed: ______________________ Date: APR 08 2008

HENRY A. OBERING III
Lieutenant General, USAF
Director

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EXECUTIVE SUMMARY

Introduction

The National Environmental Policy Act (NEPA) of 1969, as amended; the Council on Environmental Quality (CEQ) regulations that implement NEPA (Code of Federal Regulations [CFR], Title 40, Parts 1500-1508); Department of Defense (DoD) Instruction 4715.9 *Environmental Planning and Analysis*; applicable service environmental regulations that implement these laws and regulations; and Executive Order (EO) 12114, Environmental Effects Abroad of Major Federal Actions (whose implementation is guided by NEPA and the CEQ implementing regulations) direct DoD lead agency officials to consider potential impacts to the environment when authorizing or approving Federal actions.

This Programmatic Environmental Impact Statement (PEIS) evaluates the potential environmental impacts of activities associated with the development, testing, deployment, and planning for decommissioning of the Ballistic Missile Defense System (BMDS). This PEIS considers the current technology components, assets, and programs that make up the proposed BMDS as well as the development and application of new technologies, and considers cumulative impacts of implementing the BMDS. A programmatic NEPA evaluation is the appropriate approach for projects that are large in scope, diverse geographically, and implemented in phases over many years. It provides the analytical framework that supports subsequent NEPA analysis of specific actions at specific locations within the overall system, i.e., tiering.

Purpose and Need for the Proposed Action

The purpose of the proposed action is for the Missile Defense Agency (MDA) to incrementally develop and field a BMDS that layers defenses to intercept ballistic missiles of all ranges in all phases of flight. The proposed action is needed to protect the United States (U.S.), its deployed forces, friends, and allies from ballistic missile threats. The BMDS is a key component of U.S. policy for addressing ballistic missile threats worldwide.

Proposed Action

The MDA is proposing to develop, test, deploy, and to plan for related decommissioning activities for an integrated BMDS using existing infrastructure and capabilities, when feasible, as well as emerging and new technologies, to meet current and evolving ballistic missile threats. The Secretary of Defense assigned this critical defense mission to the MDA.

Scope of the PEIS

This PEIS identifies, evaluates, and documents the potential environmental effects of developing, testing, deploying, and planning for the eventual decommissioning of a BMDS. Although extensive environmental analysis already exists for many of the existing and projected components of the proposed BMDS, this PEIS examines potential environmental impacts of MDA's concept for developing an integrated system, based on current Congressional and Presidential direction. The BMDS PEIS also assesses whether cumulative environmental effects would result from implementing the proposed action. Further, the BMDS PEIS provides the analytical framework for tiering subsequent specific NEPA analyses of activities including increasingly complex and robust System Integration Testing.

Consultation and Coordination

The MDA, as the lead agency responsible for preparing this PEIS, is required to coordinate with affected Federal, state, local, and tribal agencies, and other interested parties. The MDA identified several agencies that may be cooperating or consulting agencies within the requirements of NEPA for this PEIS. These agencies include National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries Service), U.S. Fish and Wildlife Service, the Advisory Council on Historic Preservation (ACHP), and the Federal Aviation Administration (FAA).

Consulting agencies may submit comments and provide data to support the environmental analysis, but they do not participate in the internal review of documents, issues, and analyses. A cooperating agency is any Federal agency, other than a lead agency, that has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or reasonable alternative) for legislation or other Federal action significantly affecting the quality of the human environment. (40 CFR 1508.5) MDA has held informal meetings with several agencies; however, MDA has not requested that any agencies participate as cooperating agencies for this PEIS.

Public Involvement

The MDA provided several opportunities and means for public involvement throughout the preparation of the BMDS PEIS. The CEQ implementing regulations for NEPA describe the public involvement requirements for agencies. (40 CFR 1506.6) Public participation in the NEPA process provides for and encourages open communication between the MDA and the public, thus promoting better decision-making.

Public involvement for the development of the BMDS PEIS began with the publication of the Notice of Intent (NOI) in the *Federal Register* (FR) (68 FR 17784) on April 11, 2003. The MDA invited the participation of Federal, state, and local agencies, Native

American Tribes, environmental groups, organizations, citizens, and other interested parties to assist in determining the scope and significant issues to be evaluated in the BMDS PEIS. MDA held public scoping meetings in accordance with CEQ regulations. (40 CFR 1501.7) Meetings took place in Arlington, Virginia on April 30, 2003; Sacramento, California on May 6, 2003; Anchorage, Alaska on May 8, 2003; and Honolulu, Hawaii on May 13, 2003. The purpose of the scoping meetings was to solicit input from the public on concerns regarding the proposed activities as well as to gather information and knowledge of issues relevant to analyzing the environmental impacts of the BMDS. The public scoping meetings also provided the public with an opportunity to learn more about the MDA's proposed action and alternatives. The MDA developed a publicly accessible web site, http://www.mda.mil/mdalink/html/mdalink.html, to provide information on the BMDS PEIS and request scoping comments. The MDA also established a toll-free phone and fax line, e-mail address, and U.S. postal service mailbox for submittal of public comments and questions.

During scoping, the MDA received 285 comments. Comments received pertaining to reasonable alternatives to the proposed action, resource areas, human health, and environmental impacts have been considered in this PEIS.

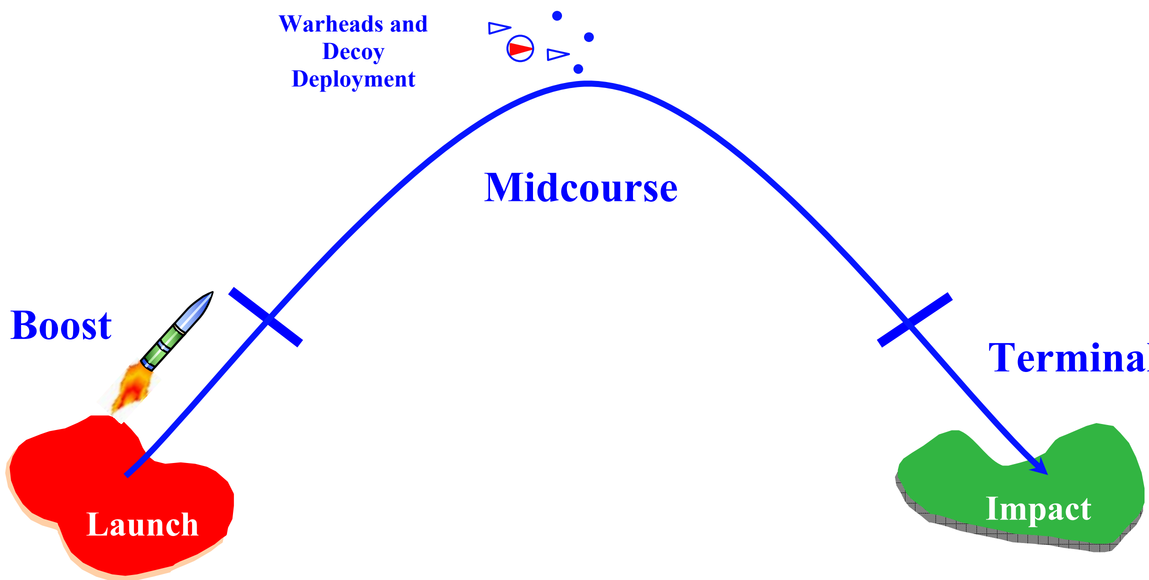
The public comment period began with the publication of the Notice of Availability (NOA) on September 17, 2004 in the FR by the Environmental Protection Agency (EPA). The NOA announced the availability of the Draft PEIS and requested comments on it. A downloadable version of the Draft PEIS was available on the BMDS PEIS web site and hardcopies of the document were placed in public libraries in the cities holding the public hearings. In October, 2004 MDA held public hearings in Arlington, Virginia; Sacramento, California; Anchorage, Alaska; and Honolulu, Hawaii. The MDA also placed legal notices in local and regional newspapers and notified state representatives of the public hearings. The purpose of these hearings was to solicit comments on the environmental areas analyzed and considered in the Draft PEIS. Appendix B contains a detailed description of the public comment period and a reproduction of the transcripts of the public hearings. The MDA's consideration of the approximately 8,500 comments received on the Draft PEIS and responses to in-scope comments can be found in Appendix K of this PEIS. Additional areas of analysis—orbital debris, perchlorate, and radar impacts to wildlife—are addressed in more technical detail in Appendices L, M, and N. The Final BMDS PEIS will be available for download at the site address listed above.

The Proposed BMDS

Conceptually, the BMDS would be a layered system of defensive weapons (i.e., lasers and interceptors); sensors (i.e., radars, infrared, optical, and lasers); Command and Control, Battle Management, and Communications (C2BMC); and support assets (i.e., auxiliary equipment, infrastructure and test assets); each with specific functional

capabilities, working together to defend against all classes and ranges of threat ballistic missiles in the three flight phases. A flight phase is a portion of the path taken by a threat missile moving through the atmosphere or space. The three flight phases of a ballistic missile are boost, midcourse, and terminal. Exhibit ES-1 describes these three phases. Multiple defensive weapons would be used to create a layered defense comprised of multiple intercept opportunities.

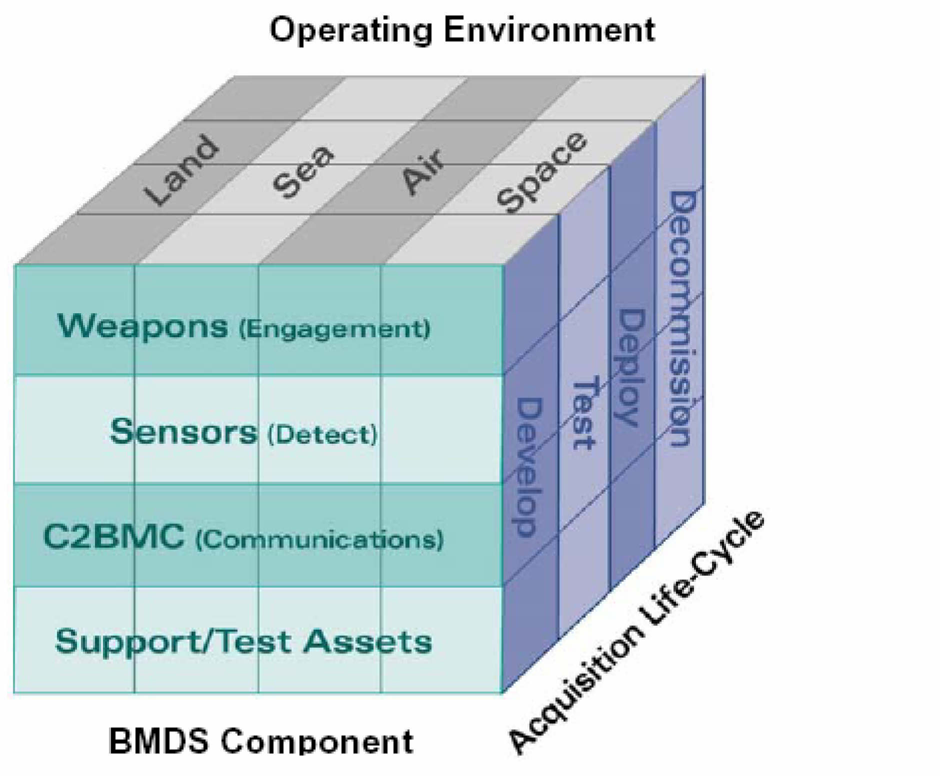
Exhibit ES-1. Ballistic Missile Flight Phases



Flight Phase	Description
Boost	First phase - rocket engine is ignited, missile lifts off and sets out on a specific path.
Midcourse	Second phase - begins when the rocket engine cuts off and the missile continues on a ballistic trajectory. Warheads and decoys may be deployed in this phase.
Terminal	Third phase - final portion of a ballistic trajectory between the midcourse phase and trajectory termination.

To determine environmental impacts, this PEIS analyzes the proposed BMDS in terms of its components, i.e., weapons, sensors, C2BMC, and support assets. These components become part of the BMDS through the acquisition life cycle phases – develop, test, deploy, and decommission. The components and activities could occur in various land, sea, air, and space operating environments. Exhibit ES-2 depicts the multi-dimensional complexities involved in considering the impacts of implementing an integrated BMDS.

Exhibit ES-2. Complexities of an Integrated BMDS



Components of the BMDS

The proposed BMDS would be comprised of components, i.e., weapons, sensors, C2BMC, and support assets. These are the systems and subsystems of logically grouped hardware and software that perform interacting tasks to provide BMDS functional capabilities. Historically, MDA primarily focused on developing stand-alone elements with specific defensive capabilities. The proposed approach maximizes flexibility to develop and test an integrated system while allowing initial capabilities to be fielded.

- **Weapons**. Weapons consisting of interceptors and high energy lasers (HELs) would be used to negate threat missiles. Interceptors would use either direct impact or directed fragmentation technology. BMDS weapons are designed to intercept threat ballistic missiles in one or more phases of flight and could be activated from land, sea-, air-, or space-based platforms.

- **Sensors**. BMDS sensors provide the relevant incoming data for threat ballistic missiles. They acquire, record, and process data on threat missiles and interceptor missiles; detect and track threat missiles; direct interceptor missiles or other defenses (e.g., lasers); and assess whether a threat missile has been destroyed. These sensors include signal-processing subcomponents, which receive raw data and use hardware and software to process these data to determine the threat missile's location, direction,

velocity, and altitude. The data from these sensors would travel through the communication systems of the proposed BMDS to Command and Control (C2) where a decision would be made to employ a defensive weapon such as launching an interceptor. The technologies used by existing and proposed BMDS sensors are based on the frequency or electromagnetic (EM) energy spectrum used by the sensor and include radar, infrared, optical, and laser systems.

- **C2BMC**. C2BMC would effectively integrate all components of the BMDS and would consist of electronic equipment and software that enable military commanders to receive and process information, make decisions, and communicate those decisions regarding the engagement of threat missiles. Specifically, C2BMC would receive, fuse, and display tracking and status data from multiple components so that commanders at various locations would have the same integrated operating picture and could make coordinated decisions about deploying weapons. The BMDS C2BMC includes three primary parts, C2, Battle Management (BM), and Communications. C2 would provide an integrated architecture to plan, direct, control, and monitor BMDS activities. BM would control the launching or firing of missiles and integrate the surveillance, detect/track/classify, engage, and assess across the layered defenses. Communications would allow all BMDS components to exchange data and network with BMDS assets.

- **Support Assets**. Support assets would be used to facilitate BMDS development, testing, and deployment. Support assets include support equipment, infrastructure, and test assets. Support equipment includes general transportation and portable equipment (e.g., automotive, ships, aircraft, rail, generators); BMDS Test Bed equipment (e.g., aircraft, vehicles, ships, mobile launch platforms, operator control units, sensor operations equipment [antennas, electronic equipment, cooling units, prime power units]); and weapons basing platforms (e.g., Aegis Cruiser and Airborne Laser [ABL] aircraft). Infrastructure includes docks, shipyards, launch facilities, and airports/air stations. Test assets include test range facilities, targets (missiles and drones), countermeasure devices, simulants, test sensors, optical and infrared cameras, computers, and observation vehicles. These test assets would simulate a threat missile in a realistic environment and assess and provide data used to enhance the performance of BMDS components in negating those threats. Some of the equipment (i.e., radar and tracking stations) and infrastructure (e.g., launch facilities) and all of the test assets comprise the BMDS Test Bed.

Acquisition Life Cycle Phases

The MDA, as the acquisition agency for the BMDS, has implemented a new, more flexible approach to its development. This approach is capability driven and component-based. Capability-based planning allows MDA to develop capabilities and system performance objectives based on technology feasibility, engineering analyses, and the

potential capability of the threat. Spiral development is an iterative process for developing the BMDS by refining program objectives as technology becomes available through research and testing with continuous feedback among MDA, the test community, and the military operators. Thus, MDA can consider deployment of a missile defense system that has no specified final architecture and no set of operational requirements but which will be improved incrementally over time. Development, testing, and deployment of an integrated BMDS would occur over several years using this evolutionary, spiral development process. Each new technology would go through development; promising technologies would go through testing and demonstration; and proven technologies would be incorporated into the BMDS.

- **Development**. Development includes the various activities that would support research and development of the BMDS components and overall systems. This would include planning, budgeting, research and development, systems engineering, site preparation and construction, repair, maintenance and sustainment, manufacture of test articles and initial testing, including modeling, simulation, and tabletop exercises.

- **Testing**. Testing of the BMDS involves demonstration of BMDS elements and components through test and evaluation. The successful demonstration of the BMDS would rely on a robust testing program aimed at producing credible system characterization, verification, and assessment data. To confirm these capabilities, MDA would continue to develop Test Beds using existing and new land-, sea-, air-, and space-based assets. Some construction at various geographic locations would be required to support infrastructure and assets where BMDS components and the overall system would be tested. Testing of the BMDS includes ongoing and planned tests (e.g., ground tests [GTs], flight tests) of components that might be incorporated into the BMDS, as well as tests of the layered, integrated BMDS through increasingly realistic System Integration Tests through 2010 and beyond.

- **Deployment**. Deployment of the BMDS refers to the fielding (including the manufacture, site preparation, construction and transport of systems) and sustainment (including operations and maintenance, training, upgrades, and service life extension) of BMDS architecture. The evolving BMDS is intended to have the capability over time to deploy different combinations of interoperable components. Deployment also would involve the transfer of facilities, elements and programs to the military services. On December 17, 2002, President Bush directed the fielding of initial defensive operation (IDO) capabilities by 2004, which would provide limited protection to defend the U.S. against ballistic missile attack. In October 2004, MDA achieved a limited missile defense capability (LDC) when certain BMDS components could also be placed on alert and used in defensive operations.

- **Decommissioning**. Decommissioning would involve the demilitarization and final removal and disposal of the BMDS components and assets. Plans would be made for

decommissioning BMDS components by either demolition or transfer to other uses or owners.

Alternatives

In this PEIS, MDA considers two alternatives to implementing an integrated BMDS that address the use of weapons components from land-, sea-, air-, and space-based platforms in addition to the No Action alternative as required by NEPA.

- **Alternative 1**. Under Alternative 1, the MDA would develop, test, deploy, and plan to decommission land-, sea-, and air-based platforms for BMDS weapons components and related architecture and assets. Alternative 1 would include space-based sensors, but would not include space-based defensive weapons.

- **Alternative 2.** Under Alternative 2, the MDA would develop, test, deploy, and plan to decommission land-, sea-, air-, and space-based platforms for BMDS weapons components and related architecture and assets. Alternative 2 would be identical to Alternative 1, with the addition of space-based defensive weapons.

- **No Action Alternative**. Under No Action the MDA would not develop, test, deploy, or plan for decommissioning activities for an integrated BMDS. Instead, the MDA would continue existing development and testing of discrete systems as stand-alone missile defense capabilities. Individual systems would continue to be tested but would not be subjected to System Integration Tests.

Affected Environment

To assess the impacts of implementing the proposed BMDS, it is necessary to characterize the existing condition of the affected environment in the locations where various BMDS implementation activities are proposed to occur. The affected environment includes all land, air, water, and space environments where proposed activities are reasonably foreseeable. For this PEIS, the affected environment includes all existing locations for ranges, installations, and facilities that the MDA has used, uses, or proposes to use for the BMDS both in the U.S. and outside the continental U.S. MDA determined that activities associated with the proposed BMDS might occur in locations around the world. Therefore, the affected environment has been considered in terms of global biomes, broad ocean areas, and the atmosphere.

Each biome covers a broad region, both geographically and ecologically for both domestic and international locations where components of the proposed BMDS may be located or operated. Climate, geography, geology, and distribution of vegetation and wildlife determine the distribution of the biomes. Using biomes as affected environment designations enables future site-specific environmental documentation to tier from this

PEIS. Note that there are no reasonably foreseeable BMDS activities that would occur in Antarctica; therefore, it is not included among the terrestrial biomes.

The affected environment has been divided into nine terrestrial biomes, the Broad Ocean Area (BOA), and the Atmosphere. Exhibit ES-3 describes the affected environment, and Exhibit ES-4 illustrates the global distribution of the biomes.

Exhibit ES-3. Affected Environment Descriptions[1]

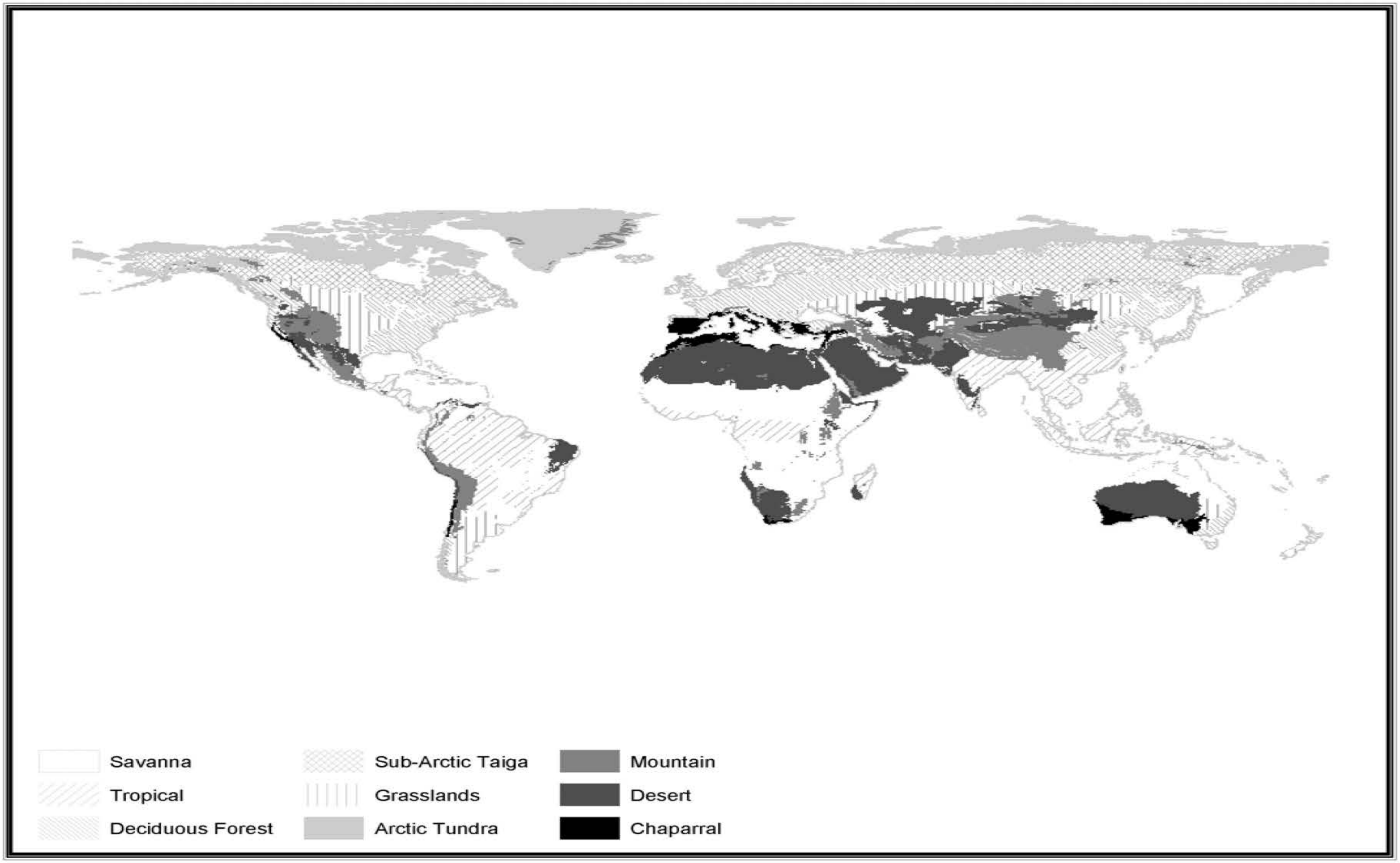
Description	Latitudinal Location	Areas of Interest for the BMDS
Arctic Tundra Biome	Areas above 60° North	Arctic regions of North America and the arctic coastal regions that border the North Atlantic Ocean, North Pacific Ocean, and Arctic Ocean, including parts of Alaska, Canada, and Greenland
Sub-Arctic Taiga Biome	Between 50° and 60° North	Sub-arctic regions of North America and sub-arctic coastal regions that border the North Pacific Ocean, including portions of Alaska
Deciduous Forest Biome	Mid-latitudes, between the polar regions and tropical regions	Eastern and northwestern U.S. and portions of Europe
Chaparral Biome	Western coastal regions of continents between 30° and 40° both North and South of the equator	Portion of the California coast and coastal region of the Mediterranean from the Alps to the Sahara Desert and from the Atlantic Ocean to the Caspian Sea
Grasslands Biome	No particular latitudinal range; occurs in the interior of all continents, except Antarctica	Prairie regions of Midwestern U.S.
Desert Biome	Between 15° and 35° both North and South of the equator	Arid environment of southwestern U.S.

[1] The latitudinal designations identify the general location for each biome; however, the biomes do not have rigid edges that begin and end at these latitudes. Therefore, there may be some overlap of biomes at or near these latitudinal designations.

Exhibit ES-3. Affected Environment Descriptions[1]

Description	Latitudinal Location	Areas of Interest for the BMDS
Mountain Biome	No particular latitudinal range; applies to areas with high elevations just below and above the snow line of a mountain	Rocky Mountains in the western U.S. and Alps in Central Europe
Tropical Biome	Between 23.5° North (Tropic of Cancer) and 23.5° South (Tropic of Capricorn)	Pacific Equatorial Islands
Savanna Biome	Between 5° and 20° both North and South of the equator	Northern Australia
BOA	No particular latitudinal range	Pacific, Atlantic and Indian Oceans
Atmosphere	No particular latitudinal range; refers to the atmosphere that envelops the entire Earth	Four principal atmospheric layers: troposphere, stratosphere, mesosphere, and ionosphere (or thermosphere)

Exhibit ES-4. Map of Global Biomes



Source: Modified From National Geographic, 2003b

The characteristics (e.g., climate, soil types, flora and fauna) that define global biomes are the same regardless of whether the biome area of concern is coastal or inland. However, unique features (e.g., wetlands, estuaries, wind currents, hurricanes) of coastal biome areas may affect the environmental impacts. Therefore, the Affected Environment discusses these unique features within the biome descriptions. Describing coastal areas as part of the larger inland biomes minimizes repetition among the descriptions yet captures the important aspects of the coastal areas in a way suitable for impacts analysis. For this PEIS, the existing environmental conditions within each biome, as well as the BOA and the Atmosphere, were assessed based on several resource areas, as appropriate.

Resource Areas

The resource areas considered in this analysis are those resources that can potentially be affected by implementing the proposed BMDS. Some resource areas are site-specific or local in nature and therefore cannot be effectively analyzed in this type of programmatic document. The potential impacts on these resource areas are more appropriately discussed in subsequent site-specific documentation, tiered from this PEIS. The resource areas analyzed in this PEIS include: air quality, airspace, biological resources, geology and soils, hazardous materials and hazardous waste, health and safety, noise, transportation, and water resources. The MDA has included orbital debris as a resource consideration because of the likelihood of orbital debris occurring from various launch and test activities and its potential for impact to health and safety and the environment.

Other resource areas including cultural resources, environmental justice, land use, socioeconomics, utilities, and visual resources depend upon site-specific or local factors. Each of these was discussed regarding methodology and thresholds for significance to provide the reader with a “roadmap” for performing future site-specific analyses tiering from this PEIS. These discussions outline the types of information that would be needed to conduct site-specific analyses and identify the steps necessary to ensure that potential impacts are thoroughly and appropriately considered.

Environmental Consequences

To determine environmental consequences or impacts of implementing the proposed BMDS, its components (i.e., weapons, sensors, C2BMC, and support assets) were considered as they are developed, tested, deployed and decommissioned during these acquisition life cycle phases. Not all of the activities associated with the proposed BMDS are expected to produce environmental impacts. Only those activities with expected impacts for each life cycle phase are identified. Further, only those activities that are considered reasonably foreseeable are analyzed in this PEIS. BMDS programs that are largely conceptual are not analyzed in this document.

Because of the extensive nature of this project, this PEIS analyzes the BMDS as described in the following four steps.

Step 1 – Identify and Characterize Activities

The BMDS is organized by component (i.e., weapons; sensors; C2BMC; and support assets). Each component has life cycle phase activities associated with developing, testing, deploying, and decommissioning those components within the BMDS. These activities produce environmental impacts, which are examined in this PEIS. To consider impacts of the BMDS, the emissions/stressors from the component life cycle phases were identified and characterized.

Step 2 – Identify Activities with No Potential for Impact

Once the activities were identified, analysis revealed that some of those activities had no potential for (significant) impact. This conclusion was reached because either previous NEPA analysis revealed insignificant impacts, or because the activity was typically categorically excluded. These activities are not further analyzed in this PEIS.

Step 3 – Identify Similar Activities across Life Cycle Phases

The remaining activities with the potential for environmental impacts were then examined to determine which had similar environmental impacts. For example, impacts associated with site preparation and construction in the development phase would be the same as impacts from site preparation and construction activities in the testing and deployment phases of the life cycle. Accordingly many activities were addressed together to eliminate redundancy.

Step 4 – Conduct Environmental Analyses

The final step in the BMDS analysis is to determine the respective impact resulting from the proposed activities. The significance of an impact that an activity has on the environment is a function of the nature of the receiving environment. For example, a booster launch has different emissions than those resulting from activating a chemical laser. Whether those emissions create impacts and the degree of significance of these impacts depends, among other things, upon the environment in which they are released.

In this analysis, the PEIS considers the emissions/stressors from each component's activity in the context of each resource area (e.g., air quality, biological resources, water resources, etc.). Impacts were distinguished based on the different operating environments (land, sea, and air for Alternative 1 and land, sea, air, and space for Alternative 2) in which the activity would occur. These impacts were further distinguished based on the worldwide biomes in which the activity would occur.

As a result, the PEIS is organized by BMDS component, examining each resource area, and distinguishing between operating environments in the context of a particular biome. The analysis describes where the impacts differ based on the operating environment or biome.

Life Cycle Phase Activities

Development phase activities with the potential to produce environmental impacts include site preparation and construction and testing. Both of these activities occur in other life cycle phases for the proposed BMDS, and so the analysis has been combined where appropriate. For example, testing of component prototypes (development phase) has been assumed to cause the same or similar impacts as testing of component test articles (test phase), and so these activities were analyzed as one activity.

Test phase activities were considered in two distinct analyses: one focused on the components and their individual test activities, and the other focused on System Integration Testing which could include multiple components with one or more attempted intercepts to test system capability and effectiveness in increasingly robust and realistic test scenarios.

Component test activities assumed to have potential impacts on the environment were considered for each component as shown in Exhibit ES-5.

Exhibit ES-5. Component Test Activities with Potential Impacts

Component	Activity	Source of Impact	Impacts Analysis
Weapons-Laser	Manufacturing of Test Articles	Manufacturing/assembly of laser components and chemicals	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support laser use/firing	Section 4.1.1.9 Support Assets - Infrastructure

Exhibit ES-5. Component Test Activities with Potential Impacts

Component	Activity	Source of Impact	Impacts Analysis
	Transportation	Transport of the laser and chemicals to appropriate location	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Support Equipment
	Activation	Firing the laser	Section 4.1.1.1 Weapons - Lasers
Weapons-Interceptor	Manufacturing of Test Articles	Manufacturing interceptor components and propellants	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support launch	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of the booster, kill vehicle, and propellants to the launch location	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Prelaunch	Assembly and fueling of the booster or kill vehicle, as appropriate	Section 4.1.1.2 Weapons - Interceptors

Exhibit ES-5. Component Test Activities with Potential Impacts

Component	Activity	Source of Impact	Impacts Analysis
	Launch/Flight	Ignition of rocket motors and flight of boosters or separation of kill vehicle and subsequent flight along its trajectory	Section 4.1.1.2 Weapons - Interceptors
	Postlaunch	Clean up or debris recovery, if required	Section 4.1.1.2 Weapons - Interceptors
Sensors	Manufacturing	Manufacturing/assembly of the sensor hardware and software	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support sensor use	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of the sensor to appropriate location	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Use of the sensor	Sections 4.1.1.3 Sensors - Radar, 4.1.1.4 Sensors - Infrared and Optical, and 4.1.1.5 Sensors - Laser

Exhibit ES-5. Component Test Activities with Potential Impacts

Component	Activity	Source of Impact	Impacts Analysis
C2BMC	Manufacturing	Assembly of associated hardware and software	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modification for computer terminals, antennas, and underground cable trenching	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of C2BMC to appropriate location	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Use of computer terminals, antennas, and underground cable	Sections 4.1.1.6 C2BMC - Computer Terminal and Antennas, 4.1.1.7 C2BMC - Underground Cable
Support Assets-Support Equipment	Manufacturing	New or major modification of existing support equipment	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets

Exhibit ES-5. Component Test Activities with Potential Impacts

Component	Activity	Source of Impact	Impacts Analysis
	Operational Changes	Implementation of new operating parameters of existing support equipment	Section 4.1.1.8 Support Assets - Equipment
	Site Preparation and Construction	New construction or major modification of existing infrastructure	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of support equipment	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
Support Assets-Infrastructure	Site Preparation and Construction	Construction or modification of infrastructure	Section 4.1.1.9 Support Assets - Infrastructure
Support Assets-Test Assets	Manufacturing	Assembly of hardware/software associated with the test sensor	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support the test sensor or launch	Section 4.1.1.9 Support Assets - Infrastructure

Exhibit ES-5. Component Test Activities with Potential Impacts

Component	Activity	Source of Impact	Impacts Analysis
	Transportation	Transport of the sensor, booster and propellants to the test location	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Use of the test sensor in a test event	Section 4.1.1.3 Sensors - Radar, 4.1.1.4 Sensors - Infrared and Optical, and 4.1.1.5 Sensors - Laser
	Prelaunch	Assembly and fueling of the booster as appropriate	Section 4.1.1.2 Weapons - Interceptors
	Launch/Flight	Ignition of rocket motors, separation from launch platform, and flight of the boosters or separation of the target object and subsequent flight along its trajectory	Section 4.1.1.2 Weapons - Interceptors
	Use of Countermeasures, Simulants or Drones	Use and deployment of various countermeasures, simulants a or drones to support testing	Section 4.1.1.10 Support Assets - Test Assets
	Postlaunch	Clean up or debris recovery to include launch platform, countermeasures, and simulants, if required	Section 4.1.1.2 Weapons - Interceptors

System Integration Testing of the BMDS would occur at the system level. System Integration Tests evaluate the ability of various component configurations to work together. System Integration Testing would be used to assess the ability of BMDS

components to work interoperably to meet the required functional capabilities of the BMDS as a system and to demonstrate performance. System Integration Tests would integrate existing and planned components such as sensors, weapons, and C2BMC. This PEIS assesses the potential for environmental impacts of integrated BMDS testing under Alternatives 1 and 2. Test integration activities would involve land-, sea-, and air-based operating environments for weapons; and land-, sea-, air- and space-based operating environments for sensors, C2BMC, and support assets for Alternative 1. Assessment of Alternative 2 considers only the additional impacts of the proposed space-based operating environment for interceptors. System Integration Tests with the potential for environmental impacts are shown in Exhibit ES-6.

Exhibit ES-6. Description of System Integration Tests

Test	Activities
Integrated Ground Tests (GTs)	GTs are tests used to collect data for BMDS components characterization and assessment and do not include booster function flight tests. GTs aim to reproduce the existing state of BMDS architecture, typically components scheduled for upcoming flight tests, to prepare for those flight tests and to assess component performance. For the purposes of this PEIS GTs do not include activities associated with components but rather have been focused on System Integration Testing.
System Integration Flight Tests (SIFTs)	SIFTs are conducted to verify the integration of select BMDS components. These tests generally include a target launch, sensors tracking the target, laser activation or an interceptor launch, and sensors to determine whether the target was destroyed. The number of sensors, weapons, and targets used in a SIFT can be adjusted to create the desired test scenario.

The analysis of intercept impacts includes a discussion of the impact of debris from an intercept. Depending on the location used for testing or deployment of weapons, debris may impact either inland or in marine environments. Therefore, impacts from postlaunch activities involving intercepts are subcategorized based on where intercept debris would be likely to impact. For any single intercept, it was assumed that the debris impacts would occur within a single receiving environment, either on land or in water.

Not all test activities would have environmental impacts and MDA has determined that modeling, simulation and analysis; modeling defense integration exercises; and integrated missile defense wargames would not result in significant impacts. These are virtual tests (modeling and computational analysis) or software compatibility and communication tests that would be conducted within existing laboratory or test facilities.

Deployment activities with potential impacts on the environment would include production of the components, site preparation and construction, use of human services, transport of components to the deployment site, testing (prelaunch, launch/flight, activation, postlaunch) and maintenance or sustainment of the components. For purposes of this analysis, the environmental impacts associated with transportation are assumed to be the same as the impacts associated with transporting the components to a test location and the impacts associated with maintenance are assumed to be the same as or similar to the impacts associated with manufacturing activities.

Decommissioning activities would include demilitarization and disposal or replacement of the component, recycling and disposal of hazardous materials. The environmental impacts associated with decommissioning of specific components would be more appropriately addressed in subsequent tiered environmental analyses; however, this PEIS provides a roadmap for considering impacts of decommissioning for each component.

Impacts from accidents and spills are considered where appropriate in this analysis. Specifically, the impacts from booster failures and from spills or releases of laser chemicals, booster propellants, and fuels used to power support assets have been considered. Boosters can fail on or directly above the launch pad or at some point during flight. If a booster fails on or above the pad, there is a potential for damage to infrastructure at and around the launch area. The impact of this type of booster failure is most appropriately addressed in site-specific analysis. If a booster fails during flight, it may be possible to use a Flight Termination System (FTS), if there is one on the vehicle, to destroy the booster. In this instance, the resulting debris would be similar to that produced during an intercept. If an FTS is not used, the booster would fall substantially intact to the surface. The resulting impact from both in-flight failures would depend on the specific location and when in the flight the failure occurred. The quantity of residual propellant released may be greater under a booster failure then during a successful booster flight or intercept. Spills or releases of propellants and fuels would be handled in accordance with standard operating procedures at each facility, range or installation, and therefore, would not be expected to pose significant impacts to the environment.

Cumulative impacts of Alternative 1 and Alternative 2 have been considered in this PEIS. The CEQ NEPA regulations define cumulative impacts as those impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. (40 CFR 1508.7)

Summary of Environmental Impacts – Alternative

This alternative considers the use of land-, sea-, and air-based platforms for BMDS weapons components. Alternative 1 would include space-based sensors, but would not include space-based defensive weapons. A summary of potential environmental effects

from Alternative 1 is provided by subcomponent in Exhibits ES-7 through ES-10. The summary tables are organized by component and subcomponent. The analyses are specific to each resource area based on the impacts from the activities associated with the subcomponent. The impacts associated with the manufacturing, site preparation and construction, and transportation activities of components are discussed under Support Assets.

Exhibit ES-7. Summary of Environmental Impacts of Alternative 1 - Weapons

Resource Area	Lasers	Interceptors
Air Quality	Emissions from laser operation (less than 30 seconds) would be minimal and would be dispersed by wind and would not significantly affect local or regional air quality.	Negligible amounts of fuel and oxidizer vapors might be released during propellant transfers. Most launch emissions would be dispersed by wind and would not significantly affect local or regional air quality or ozone depletion.
Airspace	Following required scheduling and coordination procedures would minimize the potential for adverse impacts to airspace.	Following required scheduling and coordination procedures would minimize potential for adverse impacts to airspace.
Biological Resources	Emissions, noise, and the laser beam from laser activation could negatively impact biological resources. Emitted chlorine might damage vegetation; hydrogen chloride (HCl) might irritate birds flying through the exhaust cloud or reach and disrupt aquatic ecosystems. Wildlife could be startled by noise from laser support equipment. The laser beam could pose fire hazards to vegetation and eye and skin hazards to wildlife. However, impacts to these resources would be minimal if the beam is contained or directed upward.	The presence of launch-related personnel prior to launch, launch noise, and launch emissions could impact biological resources during launch; however, launches are relatively infrequent and would not be expected to significantly impact wildlife. Debris impacting water has the potential to cause non-acoustic effects to biological resources from physical impact from falling debris, entanglement in debris, and contact with or ingestion of debris or propellants. However, these effects would not significantly impact biological resources.
Geology and Soils	Soil acidity might be affected as a result of chlorine emissions from laser activation. Magnitude of impact would be related to the amount of limestone in the soils. However, chlorine emissions are small and laser activation relatively infrequent and the impacts to geology and soils would not be significant.	Potential impacts would not be significant. Launch emissions that occur above the mixing height or above the troposphere would not cause impacts. Soil acidity might be affected as a result of HCl emissions from some launch activities. Magnitude of impact would be related to the amount of limestone in the soils. Debris from boosters and kill vehicles could hit and affect the surface and soils where they impact, but there would be no significant impact on geology.
Hazardous Materials and Hazardous Waste	Spent laser chemicals and wastewater would be treated and disposed in accordance with applicable transport and management regulations to prevent impacts. Therefore, no significant impacts from hazardous materials or hazardous waste would be expected.	Applicable regulations and operating procedures would be followed and would prevent impacts from improper transport, management, or disposal of hazardous materials or hazardous waste.
Health and Safety	Following spill prevention and control procedures would reduce potential health and safety impacts from accidental releases of laser chemicals. Hazard distances would be established to protect against skin or eye hazards from the laser beam and inhalation hazards from air emissions; therefore, no significant health and safety impacts would be expected.	Potential health and safety impacts include exposure to explosives, contact with launch debris, and exposure to launch noise. Launches would take place on facilities with restricted access, preventing exposure of the public to these hazards. Following appropriate procedures during fueling and prelaunch operations would reduce potential impacts. On-site personnel would be protected from launch event hazards; therefore, no significant health and safety impacts would be expected.

Exhibit ES-7. Summary of Environmental Impacts of Alternative 1 - Weapons

Resource Area	Lasers	Interceptors
Noise	The public would be excluded from areas where noise from operational equipment would be detrimental and workers would use recommended hearing protection. Therefore, no significant noise impacts would be expected.	The launch and flight of boosters would produce launch noise and sonic booms. The public would not be in proximity to launch sites and therefore would not be exposed to significant noise levels. Launch personnel would either leave the area or wear recommended hearing protection. Therefore, no significant noise impacts would be expected.
Transportation	Air traffic might be impacted by laser activation. Following required scheduling and coordination procedures would minimize the potential for adverse impacts. No significant impacts would be expected to other transportation modes.	Impacts on traffic due to temporary road closures are not expected to be significant. Notices to Airmen (NOTAMs) and Notices to Mariner (NOTMARs) would provide sufficient warning to prevent significant impacts to air and marine transportation.
Water Resources	Some emissions from laser activation have the potential to temporarily and locally increase the acidity of surface waters. However, these emissions would be diluted and dispersed by receiving waters. Therefore, no significant water resource impacts would be expected.	Following appropriate procedures during fueling operations would reduce the potential for propellants to impact water resources. Some emissions from launches could temporarily and locally increase acidity of surface waters. However, these emissions would be diluted and dispersed by receiving waters and would not be expected to pose significant impacts to water resources.
Orbital Debris	N/A	Debris created from a booster failure while operating in the exoatmosphere would reenter Earth’s atmosphere within a few months. Because the debris would be on orbit for a relatively short time it would not have a significant impact on orbiting structures. In addition, only a small amount of debris would survive reentry and therefore no significant impacts are expected.

Exhibit ES-8. Summary of Environmental Impacts of Alternative 1 - Sensors

Resource Area	Radars	Infrared and Optical Sensors	Laser Sensors
Air Quality	Emissions from radars would be limited to generator exhaust, which are considered in Support Assets.	Emissions from infrared and optical sensors would be limited to generator exhaust, which are considered in Support Assets.	Gas laser sensors would use inert gases, e.g., helium, nitrogen (N_2), and carbon dioxide (CO_2), which can be asphyxiants. Leaks of these gases would be insignificant relative to ambient oxygen levels; therefore no significant air quality impacts would be expected.
Airspace	NOTAMs would be issued and pilots would be restricted from electromagnetic radiation (EMR) hazard areas during radar activation. Restrictions would be short term and would not significantly impact airspace.	Activation of infrared and optical sensors would not interfere with airspace; therefore, no impacts to airspace would be expected.	Ground testing of laser sensors would be conducted in an established controlled firing area. Activation of laser sensors from air platforms would occur at an upward angle above commercial aircraft traffic. Therefore, no significant airspace impacts would be expected.
Biological Resources	There may be some risk of thermal heating to birds from the COBRA DANE radar as discussed in Appendix N, Impacts of Radar on Wildlife. However, MDA has proposed mitigation measures such as limiting the use of the radar during migratory seasons and when flocks may be in the vicinity. Therefore, no significant biological resource impacts would be expected.	Activation of infrared and optical sensors would not interfere with biological resources; therefore, no significant biological resource impacts would be expected.	Birds and mammals in the laser beam path could suffer eye damage. The short duration of laser activation and small range area would minimize impacts. Direction of laser sensor beams from space platforms towards the Earth's surface, would suffer distortion from atmospheric conditions reducing the radiance level of the lasers. Therefore, no significant impacts to biological resources would be expected.
Geology and Soils	Impacts would be limited to accidental spills of diesel fuel or coolants from support generators, which are considered in Support Assets.	Impacts would be limited to accidental spills of diesel fuel or coolants from support generators, which are considered in Support Assets.	Activation of laser sensors would not impact geology and soils.
Hazardous Materials and Hazardous Waste	Applicable regulations and procedures would be followed and would minimize impacts from management of hazardous materials or waste.	Applicable regulations and procedures would be followed and would minimize impacts from management of hazardous materials or waste.	Refrigerant 404, an ozone-depleting substance, may be used to cool some laser sensors. These would be closed loop systems, with replacement of refrigerant only during routine maintenance performed according to applicable regulations, therefore, no significant impacts from hazardous materials or waste management would be expected.

Exhibit ES-8. Summary of Environmental Impacts of Alternative 1 - Sensors

Resource Area	Radars	Infrared and Optical Sensors	Laser Sensors
Health and Safety	Prior to activation of radars, an EMR survey would be conducted to consider hazards to personnel, fuels, and ordnance. Resulting recommendations would establish safety exclusion zones to minimize exposures. Safety exclusion zones would also be established to minimize high voltage exposure from generator wiring and cabling. Therefore, no significant health and safety impacts would be expected.	Activation of infrared and optical sensors would not impact health and safety. Safety exclusion zones would be established as required to minimize high voltage exposure from generator wiring and cabling.	Sensor laser beams can be hazardous to the eyes of living organisms within a certain hazard distance. Applicable regulations and procedures, such as establishing restricted areas, displaying warning signs, designating restricted areas, and removing reflective surfaces, would reduce potential health and safety impacts below significant levels. Safety exclusion zones would also be established to minimize high voltage exposure from generator wiring and cabling.
Noise	Noise impacts would be limited to noise produced by generators, which are considered in Support Assets.	Noise impacts would be limited to noise produced by generators, which are considered in Support Assets.	Noise impacts would be limited to noise produced by generators, which are considered in Support Assets.
Transportation	NOTAMs and NOTMARs would provide sufficient warning. Therefore, no significant transportation impacts would be expected.	Activation of infrared and optical sensors would not interfere with transportation. Therefore, no significant transportation impacts would be expected.	Activation of laser sensors would not interfere with transportation. Therefore, no significant transportation impacts would be expected.
Water Resources	Releases of diesel fuel or coolants from support generators into surface water would be diluted rapidly; therefore, no significant impacts to water resources would be expected.	Releases of diesel fuel or coolants from support generators into surface water would be diluted rapidly; therefore, no significant impacts to water resources would be expected.	Liquids used in laser sensor cooling systems are non-hazardous and in the unlikely event of a release would not be expected to impact water resources.
Orbital Debris	Space-based radars could reenter the Earth's atmosphere due to failure; however, most objects break up and vaporize in the upper atmosphere under intense forces and heating during reentry. Even if an object survives reentry, it would most likely land in an ocean area, and the chance of hitting populated land area would be small. Therefore, no significant orbital debris impacts would be expected.	Space-based infrared and optical sensors could reenter the Earth's atmosphere due to failure; however, most objects break up and vaporize in the upper atmosphere under intense forces and heating during reentry. Even if an object survives reentry, it would most likely land in an ocean area, and the chance of hitting populated land area would be small. Therefore, no significant orbital debris impacts would be expected.	Space-based laser sensors could reenter the Earth's atmosphere due to failure; however, most objects break up and vaporize in the upper atmosphere under intense forces and heating during reentry. Even if an object survives reentry, it would most likely land in an ocean area, and the chance of hitting populated land area would be small. Therefore, no significant orbital debris impacts would be expected.

Exhibit ES-9. Summary of Environmental Impacts of Alternative 1 - C2BMC

Resource Area	Computer Terminals and Antennas	Underground Cable
Air Quality	Activation emissions would be limited to generator exhaust. Impacts from generator emissions are considered in Support Assets.	Impacts would be limited to ground disturbances resulting from construction activities. Impacts from ground disturbance are considered in Support Assets.
Airspace	Radio transmission frequencies used by computer terminals and antennas could impact airspace through interference with commercial air traffic control communications. Radio frequency use and testing would be coordinated with the appropriate air traffic control agencies; therefore, no significant airspace impacts would be expected.	Activation of underground cable would not interfere with airspace; therefore, no significant airspace impacts would be expected.
Biological Resources	Biological resources could be impacted by activation activities, but the level of impact would vary based on signal frequency and energy, and the proximity of the source to sensitive environments or specific threatened or endangered species. Radio frequency use and testing would be coordinated with the appropriate resource management agencies; therefore, no significant biological resource impacts would be expected.	Activation of underground cable would not interfere with biological resources. Therefore, no significant biological resource impacts would be expected.
Geology and Soils	Activation of computer terminals and antennas would not interfere with geology and soils. Therefore, no significant geology and soils impacts would be expected.	Impacts to geology and soils would be limited to site preparation activities. Impacts from ground disturbance are considered in Support Assets.
Hazardous Materials and Hazardous Waste	Any hazardous materials or wastes used or generated would be handled in accordance with appropriate regulations. Therefore, no significant hazardous materials and hazardous waste impacts would be expected.	Impacts from hazardous materials and hazardous wastes would be limited to site preparation activities. Impacts from ground disturbance are considered in Support Assets.
Health and Safety	Health and safety impacts would vary based on signal frequency and energy, and the proximity of the source to site personnel or the public. No significant health and safety impacts would be expected.	Potential health and safety hazards would be limited to dust/particulate inhalation, improper chemical handling, and improper use of machinery during site preparation and construction. Impacts from ground disturbance are discussed in Support Assets.
Noise	Noise impacts associated with activation of computer terminals and antennas would be limited to noise produced by generators. Impacts related to generator noise are discussed in Support Assets.	The activation of underground cable would not produce noise that has the potential to impact sensitive receptors.
Transportation	Personnel operating and maintaining computer terminals and antennas would generate traffic as a result of activation. Personnel would be on site only during operating hours and during routine maintenance activities; therefore, no significant transportation impacts would be expected.	Any necessary repairs to underground cable would require excavation of the cable. These activities could result in impacts to transportation through movement of equipment and personnel to the repair site. However, this would occur infrequently, therefore, impacts to transportation would not be significant.

Exhibit ES-9. Summary of Environmental Impacts of Alternative 1 - C2BMC

Resource Area	Computer Terminals and Antennas	Underground Cable
Water Resources	Activation of computer terminals and antennas would not interfere with water resources. Therefore, no significant impacts would be expected.	Impacts to water resources might result from site preparation activities. Impacts from ground disturbance are considered in Support Assets.
Orbital Debris	Space-based computer equipment could reenter the Earth's atmosphere due to failure, but no significant orbital debris impacts would be expected.	N/A

Exhibit ES-10. Summary of Environmental Impacts of Alternative 1 – Support Assets

Resource Area	Support Equipment	Infrastructure	Test Assets
Air Quality	Increased use of support equipment resulting in greater quantities of emissions could impact air quality. The significance of the impact depends on the local and regional regulatory setting and the physical climate where emissions would occur.	Site preparation and construction activities would result in air emissions; however, it is assumed that the impact on air quality would be temporary and localized. Therefore, no significant air quality impacts would be expected.	The development and use of targets, simulants, countermeasures, and drones could impact air quality. Following standard operating procedures would reduce potential impacts to air quality below significant levels.
Airspace	Operational use changes of support assets would not interfere with airspace. Increases in support asset operations would be in accordance with existing airspace use regulations. Therefore, no significant airspace impacts would be expected.	Site preparation and construction would not interfere with airspace. Therefore, no significant airspace impacts would be expected.	Simulants, countermeasures, and their delivery systems (boosters) could impact airspace. Site-specific analyses would be conducted to address these potential impacts.
Biological Resources	Following required scheduling, duration of testing, and completing required agency regulatory agency consultations would reduce potential impacts on biological resources below significant levels.	Site preparation and construction activities could impact biological resources. Site-specific analyses and regulatory agency consultations would be conducted to address these potential impacts.	Potential impacts on biological resources could be associated with debris in which simulants and countermeasures were used. Site-specific analysis would be conducted to address these potential impacts.
Geology and Soils	In general, operational use changes would not be expected to significantly impact geology and soils. Mitigation measures may be used in instances where impacts could occur to reduce impacts to less than significant levels.	Construction would incorporate design parameters consistent with the geologic setting to reduce potential seismic impacts. Construction activities could impact soils; however, Best Management Practices would be implemented to minimize impacts.	Development and use of simulants and countermeasures could impact soils based on the composition of the simulant or countermeasure. Site-specific analyses would be conducted to address potential impacts.
Hazardous Materials and Hazardous Waste	Hazardous waste would be handled and disposed in accordance with appropriate regulations. Therefore, no significant hazardous materials and hazardous waste impacts would be expected.	Hazardous waste would be handled and disposed in accordance with appropriate regulations. Therefore, no significant hazardous materials and hazardous waste impacts would be expected.	Hazardous waste would be handled and disposed in accordance with appropriate regulations. Therefore, no significant hazardous materials and hazardous waste impacts would be expected.
Health and Safety	Standard operating procedures specific to an action or installation would be used and equipment training performed to reduce potential impacts to health and safety.	Standard operating procedures specific to an action or installation would be used and equipment training performed to reduce potential impacts to health and safety.	Standard operating procedures specific to an action or installation would be used and equipment training performed to reduce potential impacts to health and safety.

Exhibit ES-10. Summary of Environmental Impacts of Alternative 1 – Support Assets

Resource Area	Support Equipment	Infrastructure	Test Assets
	Therefore, no significant health and safety impacts would be expected.	Therefore, no significant health and safety impacts would be expected.	Therefore, no significant health and safety impacts would be expected.
Noise	Noise impacts are based on site-specific receptors and are regulated on a regional basis. Site-specific analysis would be conducted for actions that may have noise impacts.	Noise impacts are based on site-specific receptors and are regulated on a regional basis. Site-specific analysis would be conducted for actions that may have noise impacts.	The development and use of simulants or countermeasures would not have noise impacts. The launch and flight of targets would produce noise similar to that of interceptors. However, as described in Exhibit ES-6 no significant noise impacts would be expected.
Transportation	Operational use changes that increase the amount of time that support equipment are used could impact transportation. However, these impacts are not expected to be significant.	Site preparation and construction activities may require the use of heavy machinery and an influx of construction workers which could change the congestion and level of demand for access to the existing roadways. However, these activities would not be expected to cause a significant impact on transportation.	The development and the use of simulants would not impact transportation. Short-term road closures, the issuance of NOTAMs and NOTMARs to notify pilots and mariners of area closures, and debris recovery activities would not be expected to impact transportation.
Water Resources	Operational use changes occurring at existing facilities designed for the support equipment would not impact water resources. Operational use changes that result in impacts to areas not specifically designed for use of the support equipment could be subject to additional environmental review.	Applicable protocols and permits would reduce potential impacts to water resources from construction activities to below significant levels. Site-specific analyses would be conducted for new installations.	The development and use of simulants and countermeasures could impact water resources. Site-specific analyses would be conducted to determine and address impacts.
Orbital Debris	No impacts from orbital debris would occur as a result of the development of new or the major modification of existing equipment or an operational use change of such equipment. Space-based equipment (satellites) could reenter the Earth's atmosphere due to failure, but would not likely result in significant impacts because they would burn up on reentry.	No impacts from orbital debris would occur as a result of the development of new or the major modification of existing infrastructure.	If countermeasures are used and remain on-orbit, they have the potential to disrupt or damage space-based assets (e.g., communication satellites). However, because the debris would be on orbit for a relatively short time it would not have a significant impact on orbiting structures. In addition, only a small amount of debris would survive reentry and therefore no significant impacts are expected.

Test Integration

System Integration Tests would integrate existing and planned components such as sensors, weapons, and C2BMC. Under Alternative 1, test integration activities would involve land-, sea-, and air-based platforms for weapons; and land-, sea-, air- and space-based platforms for sensors, C2BMC, and support assets. Integrated GTs and SIFTs have the potential for environmental impacts, as described in Exhibit ES-6.

For this PEIS, two representative scenarios that could be used during SIFTs were considered for Alternative 1. These two representative scenarios involve similar activities (launches of targets, use of multiple sensors, and use of land-, sea-, and air-based weapons); however, they differ in number of target launches and number of weapons used. Both representative scenarios may be used to support the proposed BMDS and are analyzed in this PEIS. The activities associated with each type of System Integration Tests that were analyzed in this PEIS include

- **Integrated GTs**. The activation of multiple sensors and C2BMC components, and passive activation of weapons (e.g., powering the tracking and communication aspects of the weapons system but not firing the weapon) within the same biome or across several biomes, which would coordinate the control and transfer of information between land-, sea-, and air-based weapons.

- **SIFT Scenario 1- Single Weapon with Intercept**. The activation of multiple sensors and C2BMC components within the same biome or across several biomes coupled with the launch of one target and the activation of a laser or launch of an interceptor, and the debris from an intercept.

- **SIFT Scenario 2- Multiple Weapons with Multiple Intercepts**. The activation of multiple sensors and C2BMC components within the same biome or across several biomes coupled with the launch of up to two targets from the same biome or different biomes, the activation or launch of multiple weapons in the same biome or multiple biomes, and the debris from intercepts.

A summary of potential environmental effects associated with Test Integration for Alternative 1 is provided in Exhibit ES-11. The analyses are specific to each resource area based on the impacts from the activities associated with each test.

Exhibit ES-11. Summary of Environmental Impacts of Alternative 1 - Test Integration

Resource Area	GT	SIFT Scenario 1	SIFT Scenario 2
Air Quality	Emissions from generators used to power sensors and C2BMC would be a small fraction of the *de minimis* threshold and would not impact air quality. The activation of radars, infrared, and optical sensors would not impact air quality.	Emissions from launch activities and laser activation would be less than two percent of *de minimis* thresholds; impacts to air quality would be insignificant.	Impacts to air quality would be insignificant, provided the activity is within parameters of the launch facility or range.
Airspace	Coordination with the FAA Air Route Traffic Control Center (ARTCC), military installations, and foreign countries with jurisdiction over affected airspace would minimize the potential for impact. All laser sensors would be operated using appropriate range safety regulations.	Close coordination with the FAA ARTCC, military installations, and foreign countries with jurisdiction for airspace management would minimize the potential for adverse impacts on airspace use and scheduling. Upon completion of such coordination for each test, there would be no significant impacts to airspace.	Close coordination with the FAA ARTCC, military installations, and foreign countries with jurisdiction over affected airspace would reduce the potential impacts to airspace. Upon completion of such coordination for each test, there would be no significant impacts to airspace.
Biological Resources	Potential impacts to the environment and the threatened and endangered species, the unique or sensitive environments, and the migratory, breeding, and feeding activities would be evaluated in site-specific analyses.	Potential impacts to the environment and the threatened and endangered species, the unique or sensitive environments, and the migratory, breeding, and feeding activities would be evaluated in site-specific analyses.	Potential impacts to the environment and the threatened and endangered species, the unique or sensitive environments, and the migratory, breeding, and feeding activities would be evaluated in site-specific analyses.
Geology and Soils	Fuel spills associated with generators would be controlled and cleaned up according to appropriate procedures; therefore any impacts would be insignificant.	HCl and particulate emissions from interceptor and target launches would not result in significant impacts to geology and soils.	HCl and particulate emissions from interceptor and target launches would not result in significant impacts to geology and soils.
Hazardous Materials and Hazardous Waste	Hazardous materials and waste would be handled according to all applicable regulations, and each test location would have a Spill Prevention, Control and Countermeasure (SPCC) plan in place to handle any spills or leaks of hazardous materials; therefore impacts would be insignificant.	Applicable regulations and procedures would be followed and would prevent impacts from management and disposal of hazardous materials or waste associated with laser activation and target and weapons launches.	Applicable regulations and procedures would be followed and would prevent impacts from management and disposal of hazardous materials or waste associated with laser activation and target and weapons launches.
Health and Safety	All safety procedures would be followed, safety zones would be established, and participating personnel would be trained	All safety procedures would be followed, safety zones would be established, and participating personnel would be trained and certified to reduce the potential for impacts to	All safety procedures would be followed, safety zones would be established, and participating personnel would be trained and certified to reduce the potential for impacts to

Exhibit ES-11. Summary of Environmental Impacts of Alternative 1 - Test Integration

Resource Area	GT	SIFT Scenario 1	SIFT Scenario 2
	and certified to reduce the potential for impacts to health and safety.	health and safety associated with launches of targets and weapons.	health and safety associated with launches of targets and weapons. The increased exposure to health and safety risks associated with SIFT Scenario 2 would not be expected to result in a significant impact.
Noise	Generators would be operated during tests, and sea- and air-based systems typically would not be operated in proximity to sensitive receptors. In general, the increase in noise from multiple generator use within an environment would not be significant.	Noise from launches of targets and weapons and sonic booms would occur in areas away from sensitive receptors, and would not result in significant impacts.	Noise from launches of targets and weapons and sonic booms would occur in areas away from sensitive receptors, and would not result in significant impacts.
Transportation	NOTAMs and NOTMARs would be issued in advance of testing events to allow aircraft and vessels to plan alternate routes to avoid the EMR hazard areas; the impacts would be insignificant.	Closures of roads, airspace, and marine areas would be of short duration and would be considered routine occurrences for launch sites, and issuance of NOTAMs and NOTMARs would allow vehicles to clear the affected areas. Impacts to transportation would be insignificant.	The increase in transportation requirements or any increases in the frequency, duration, or number of transport route closures would not result in a significant transportation impact.
Water Resources	In general, an increase in risk from hazardous materials and hazardous waste spills and an increase in demand for potable water would not result in significant impacts.	Impacts from the deposition of emissions, propellants, and debris into water resources would be dependent on the specific biome and the unique and sensitive water resources that occur in the biome. In general, impacts to water resources from laser activation and launches would not have additive impacts for activities occurring within the same biome.	Site-specific environmental analysis would be completed to evaluate potentially significant impacts. In general, impacts to water resources from laser activation and launches would not have additive impacts for activities occurring within the same biome.

Exhibit ES-11. Summary of Environmental Impacts of Alternative 1 - Test Integration

Resource Area	GT	SIFT Scenario 1	SIFT Scenario 2
Orbital Debris	N/A	Debris created from exoatmospheric intercepts would reenter Earth's atmosphere within a few months. Because the debris would be on orbit for a relatively short time it would not have a significant impact on orbiting structures. In addition, only a small amount of debris would survive reentry and therefore no significant impacts are expected.	Debris created from exoatmospheric intercepts would reenter Earth's atmosphere within a few months. Because the debris would be on orbit for a relatively short time it would not have a significant impact on orbiting structures. In addition, only a small amount of debris would survive reentry and therefore no significant impacts are expected.

Cumulative Impacts

The implementation of the proposed BMDS under Alternative 1 is worldwide in scope and potential application, and only other actions that are international in scope, have been considered for cumulative impacts. Regional or local past, present, or future actions, which may result in cumulative impacts, would be considered during the completion of site-specific NEPA analyses. Worldwide launch programs for commercial and government programs were determined to be actions of international scope that might be reasonably considered for cumulative impacts in this PEIS. Launches contribute to cumulative impacts in areas including ozone depletion, global warming, and orbital debris.

The cumulative impact on stratospheric ozone depletion from BMDS launches would be far less than and indistinguishable from the effects caused by other natural and man-made sources. The estimated emission loads of chlorine from both BMDS and worldwide launches from 2004 to 2014 would account for only 0.5 percent of the industrial chlorine load from the U.S. over the same 10-year period. Therefore, the cumulative impacts to ozone depletion would not be significant.

The cumulative impact on global warming from BMDS launches from 2004 to 2014 would be insignificant compared to other industrial sources (e.g., energy generation using fossil fuel) and activities (e.g., deforestation and land clearing). The BMDS launch emissions load of carbon monoxide (CO) and CO_2 to the troposphere and stratosphere would be only five percent of the emissions load from worldwide launches. However, even when accounting for both BMDS launches and worldwide launches over the 10-year period, the CO and CO_2 load is extremely small compared to emissions loads from other industrial sources, accounting for 3.5×10^{-4} percent of emissions from U.S. industrial sources in just one year. Therefore, the cumulative impacts to global warming would not be significant.

Orbital debris could be produced from BMDS space-based sensors. Orbital debris that remains on orbit could create hazards to orbiting spacecraft and could have impacts upon reentry if the debris reaches the Earth’s surface in large pieces or containing hazardous materials.

Successful flight tests of the BMDS in the exoatmosphere would result in kinetic energy (i.e., hit-to-kill) intercepts that would produce both target and interceptor debris clouds. With the need for increasingly realistic test scenarios, MDA is considering high altitude, high velocity intercept tests. MDA analysis of BMDS flight tests employing ground-launched interceptors shows that the majority (90 to 95 percent) of post-intercept debris reenters the Earth's atmosphere within six hours. A small amount of post-intercept debris may become orbital debris; however, modeling indicates that risk to spacecraft from intercept debris is far lower than the risk posed by existing background debris.

Additional efforts are on-going to determine flight test risks in the space environment and resulting potential impacts on orbiting spacecraft.

The effects of orbital debris on other spacecraft would depend on the altitude, orbit, velocity, angle of impact, and mass of the debris. Debris less than 0.01 centimeter (0.004 inch) in diameter can cause surface pitting and erosion. Debris between 0.01 to 1 centimeter (0.004 and 0.4 inch) in diameter would produce significant impact damage that can be serious, depending on system vulnerability and defensive design provisions. Objects larger than one centimeter (0.4 inch) in diameter can produce catastrophic damage.

Astronauts or cosmonauts engaging in extra-vehicular activities could be vulnerable to the impact of small debris. On average, debris one millimeter (0. 04 inch) is capable of perforating current U.S. space suits.

Proposed BMDS space-based sensor activities would be expected to produce small quantities of orbital debris, primarily explosive bolts and small pieces of hardware. MDA exoatmospheric flight testing may also produce orbital debris. However, because the majority of BMDS activities would occur in Low Earth Orbit (LEO) where debris would gradually drop into successively lower orbits and eventually reenter the atmosphere, the debris would not be a permanent hazard to orbiting spacecraft. As BMDS testing becomes more realistic, there is potential for an increased amount of debris reaching and remaining on orbit. A large portion of this debris would likely not remain on orbit for more than one revolution, and eventually all of the debris would be expected to de-orbit.

Although it cannot be determined with certainty how much orbital debris would be produced from BMDS space-based sensors or intercepts annually, the fact that orbital debris reenters the Earth's atmosphere on a daily basis, and that this debris has not caused injury or significant property damage on Earth indicates that orbital debris produced by BMDS space-based sensors and potential exoatmospheric intercepts would not pose significant impacts upon reentry. Therefore the cumulative impacts of orbital debris from Alternative 1 are not expected to be significant.

Summary of Environmental Impacts - Alternative 2

This alternative includes the use of interceptors from land-, sea-, air-, and space-based platforms. The impacts associated with the use of interceptors from land, sea, and air platforms would be the same as those discussed for Alternative 1. Therefore, the analysis for Alternative 2 focuses on the impacts of using interceptors from space-based platforms. At this time although MDA has historically conducted research and development efforts on space-based lasers, these efforts have been put on hold as kinetic energy missile technology, which is more promising in the short term, is being pursued.

If Alternative 2 were selected, additional environmental analysis would be required as the technologies intended to be used become more robust. For purposes of impacts analysis for space-based interceptors it was assumed that all manufacturing activities impacts would be the same as those discussed for Alternative 1, therefore, they are not discussed in detail for Alternative 2. Space-based interceptors would be launched on launch vehicles and maintained from platforms similar to other satellites used for DoD and commercial purposes in prescribed orbits around the Earth. The launch vehicles used to insert the weapon platforms into the proper orbit would likely be existing launch vehicles; and therefore, the impacts of the launch would be as described for support assets. A summary of potential environmental effects from Alternative 2 is provided in Exhibit ES-12.

Exhibit ES-12. Summary of Environmental Impacts of Alternative 2 – Weapons[2]

Resource Area	Interceptors	Debris
Air Quality	Emissions from space-based launches would not affect the human environment; therefore, no significant air quality impacts would be expected.	Most space-based interceptors and associated platform debris would be destroyed upon reentry. Some small particles and pieces of debris may serve as reaction sites for chemical reactions in the atmosphere. Due to the infrequency of debris reentry and deorbiting events, no significant air quality impacts would be expected.
Airspace	A space-based interceptor may be directed towards the Earth during intercepts and could impact the use of airspace in the interceptor's designated path. Coordination with the appropriate FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impacts to airspace use. Therefore, no significant airspace impacts would be expected.	For controlled reentries, affected portions of airspace would be cleared of aircraft. For uncontrolled reentries, current capabilities and procedures provide a limited ability to predict when and where a particular object would reenter the Earth's atmosphere. Little advance warning could be given to clear airspace in the event of an uncontrolled reentry. However, uncontrolled reentry would occur infrequently and therefore, no significant airspace impacts would be expected.
Biological Resources	Trajectories would be carefully selected such that interceptor debris would impact in a cleared portion of the ocean or military range. It is unlikely that any interceptor debris that survives reentry would impact biological resources and no significant impacts would be expected.	Most interceptor and platform debris would be destroyed upon reentry. The debris would fall to the Earth's surface and likely terminate in open ocean waters, where impact would be limited to animals in the immediate surface waters near the impact point. Fish and marine mammals at lower depths of the ocean would have more time to react to the sound and would be able to avoid the impact area. Therefore, no significant biological resource impacts would be expected.
Geology and Soils	The launch of interceptors from space-based platforms would not impact geology and soils.	Most debris from space-based interceptors or platforms would likely not survive reentry; surviving debris would likely be very small in size. Therefore, no significant impacts would be expected to geology and soils from space-based debris.
Hazardous Materials and Hazardous Waste	The launch/flight of space-based interceptors would not produce hazardous waste that would be transported to or disposed of on Earth. Therefore, no significant hazardous material and waste impacts would be expected.	Debris contaminated with hazardous materials would be exposed to high temperatures during reentry, likely rendering the debris inert by the time it reaches the Earth's surface. Debris and deorbited material would not be considered hazardous waste. Therefore, no significant hazardous materials or waste impacts would be expected.

[2] Impacts from Alternative 2 include impacts analyzed under Alternative 1 with the addition of space-based weapons.

Exhibit ES-12. Summary of Environmental Impacts of Alternative 2 – Weapons[2]

Resource Area	Interceptors	Debris
Health and Safety	Trajectories would be selected such that, in the event of an unsuccessful intercept attempt, interceptor debris would impact in the open ocean or in designated land-based areas, which would reduce the potential for impacts to health and safety. Therefore, no significant health and safety impacts would be expected.	Trajectories would be selected such that debris would impact in the open ocean or in designated land-based areas. In the event of an uncontrolled deorbit, debris might hit and injure humans. However, the risk that an individual would be hit and injured by reentering orbital debris is estimated to be less than one in one trillion. Therefore, no significant health and safety impacts would be expected.
Noise	Launch noise from space-based launches would not be audible in the human environment and therefore, no significant impacts would be expected.	The noise produced by large pieces of debris hitting the Earth's surface might cause startle responses in nearby animals and might displace mobile species for a short time. However, as reentering debris would generally be small in size, no significant noise impacts would be expected.
Transportation	Launches from space-based platforms would not impact transportation.	Debris reaching the open ocean would most likely not be recovered. Debris recovery on land would be as described for Alternative 1, and would not have an impact on transportation.
Water Resources	Launches from space-based platforms would not impact water resources.	Debris would be rendered inert due to the high temperatures during reentry. Thus debris impacting in surface water would not impact water resources.

Test Integration

System Integration Tests would integrate existing and planned components such as sensors, weapons, C2BMC, and support assets. Under Alternative 2, System Integration Tests would involve land-, sea-, air-, and space-based platforms for weapons; and land-, sea-, air- and space-based platforms for sensors, C2BMC, and support assets.

The unique activities associated with each type of System Integration Test analyzed in this PEIS under Alternative 2 include

- **Integrated GT**. The use of additional components to control and coordinate the activities of the four weapon platforms (land-, sea-, air-, and space-based).

- **SIFT Scenario 1 – Single Weapon with Intercept**. The launch of interceptors from space-based platforms with an intercept.

- **SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts**. The launch of multiple interceptors from multiple weapon platforms (land-, sea-, air-, and space-based) at up to two targets with intercepts. Under Alternative 2, the analysis assumes that the launch of a space-based interceptor would replace a land-, sea-, or air-based weapon launch or laser activation.

A summary of potential environmental effects associated with Test Integration for Alternative 2 is provided in Exhibit ES-13. The analyses are specific to each resource area based on the impacts from the activities associated with each test.

Exhibit ES-13. Summary of Environmental Impacts of Alternative 2 - Test Integration

Resource Area	SIFT Scenario 2[3]
Air Quality	If an interceptor launch from a space-based weapon replaced an interceptor launch from a land- or sea-based weapon, a reduction in ground level emissions would occur. If the activation of an air-based weapon were replaced, then a reduction in emissions would occur in the upper atmosphere. Impacts to air quality would be less than those for Alternative 1.
Airspace	If the flight path of a space-based weapon is limited to the exoatmosphere, then the impacts to airspace would be less than those for Alternative 1. If the flight path of a space-based weapon is directed toward Earth in the endoatmosphere, then the impacts to airspace would be similar to those for Alternative 1.
Biological Resources	Interceptor launches from space-based weapons would result in fewer impacts on Earth from noise and pollutant emissions. The impacts to biological resources for Alternative 2 would be less than those for Alternative 1.
Geology and Soils	If a land-based launch is replaced by a space-based launch, then the impacts to geology and soils would be less for Alternative 2 than those for Alternative 1. If a sea- or air-based launch is replaced by a space-based launch, then the impacts to airspace would be similar to those for Alternative 1.
Hazardous Materials and Hazardous Waste	Under Alternative 2, there would be a reduction of hazardous materials use, and hazardous waste generation associated with the launch or activation of a weapon. The impacts from hazardous materials and hazardous wastes for Alternative 2 would be less than those for Alternative 1.
Health and Safety	Launching an interceptor from space rather than from land, air, or sea would result in a reduction in the number of individuals that would be exposed to health and safety risks associated with launch activities. Because no significant impacts were identified under Alternative 1 from the increased use and generation of hazardous materials and hazardous waste, no significant impacts would be expected from Alternative 2.
Noise	Noise produced from the launch of interceptors from space-based platforms would not be audible on Earth. Because no significant impacts were identified under Alternative 1 from increased noise, no significant impacts would be expected from Alternative 2.
Transportation	The transportation impacts under Alternative 2 would be the same as the impacts under Alternative 1.
Water Resources	An interceptor launch from a space-based platform would replace an interceptor launch from a land-, sea-, or air-based platform, which would result in a potential reduction in the debris and simulants that would reach a water resource based on elevation where an intercept or flight termination would occur. Impacts to water resources for Alternative 2 would be less than or equal to those for Alternative 1.
Orbital Debris	Increases in orbital debris would be greater under Alternative 2 than under Alternative 1 because a higher proportion of the tests would occur in the exoatmosphere because of testing associated with space-based interceptors. However, 90 to 95 percent of debris created from exoatmospheric intercepts would reenter Earth's atmosphere within six hours. Because the debris would be on orbit for a relatively short time it would not have a significant impact on orbiting structures. In addition, only a small amount of debris would survive reentry and therefore no significant impacts would be expected.

[3] The environmental impacts associated with GTs and SIFT Scenario 1 are not presented by resource area because such impacts were not found to be substantially different from the impacts described for Alternative 1.

Cumulative Impacts

Placing interceptors in space would add additional structures to space for extended periods of time; therefore, it is appropriate to include in this cumulative impacts analysis other programs that are international in scope which place structures in space for extended periods of time. The International Space Station (ISS) was determined to be such a program. Therefore, the cumulative impacts analysis for Alternative 2 encompasses the discussion of worldwide launch programs as discussed for Alternative 1 and includes a discussion of the impacts of the proposed BMDS on and with the ISS.

Because the majority of BMDS activities would occur in LEO where debris would gradually drop into successively lower orbits and eventually reenter the atmosphere, and the orbital debris produced by BMDS activities would be small in size and in amount, orbital debris from BMDS activities would not pose a long-term hazard to the ISS. The National Aeronautics and Space Administration (NASA) and the U.S. Air Force Space Command monitor orbiting space objects and are aware of instances when the ISS is predicted to be in proximity to space debris that has the potential to damage spacecraft. Prior to every BMDS flight test, MDA assesses the risks posed to spacecraft from post-intercept debris. Launch times are selected to preclude any conjunctions between spacecraft and intercept debris. If necessary, additional analysis is conducted to determine safe launch times within launch windows thereby minimizing the risks to spacecraft. This analysis allows MDA to determine when to safely conduct a flight test. Because the proposed BMDS activities would be expected to produce small quantities of debris which would eventually be removed from orbit and because MDA would only use launch windows when the ISS would not be in the debris, there would be no significant impacts expected to the ISS from the implementation of Alternative 2 for the BMDS.

Summary of Environmental Impacts - No Action Alternative

The No Action Alternative involves the continuation of MDA activities to develop and test discrete weapons, sensors, C2BMC, and support assets and would not include System Integration Testing of these components. For the potential sites being considered for BMDS deployment, the No Action Alternative would be a continuation of activities currently occurring or planned at those locations for individual systems. Therefore, the environmental impacts on the various resource areas associated with the No Action Alternative would be the same as the impacts resulting from continued development and testing of individual missile defense elements.

The decision not to deploy a fully integrated BMDS could result in the inability to respond to a ballistic missile attack on the U.S. or its deployed forces, allies, or friends in a timely and successful manner. Further, this alternative would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress.

ACRONYMS AND ABBREVIATIONS

ABL	Airborne Laser
ABM	Anti-Ballistic Missile
ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
AFB	Air Force Base
AFRL	Air Force Research Laboratory
ait	atmospheric interceptor technology
ALCOR	Advanced Research Project Agency Lincoln C-band Observable Radar
Al_2O_3	Aluminum Oxide (alumina)
ANSI	American National Standards Institute
AMOS	Air Force Maui Optical and Supercomputing Station
ARS	Active Ranging System
ARTCC	Air Route Traffic Control Center
AWS	Arrow Weapon System
BILL	Beacon Illuminator Laser
BM	Battle Management
BMC2	Battle Management/Command and Control
BMC3	Battle Management/Command, Control and Communications
BMDO	Ballistic Missile Defense Organization
BMDS	Ballistic Missile Defense System
BMEWS	Ballistic Missile Early Warning System
BOA	Broad Ocean Area
BTS	Bureau of Transportation Statistics
^{o}C	Degrees Celsius
C2	Command and Control
C2BMC	Command and Control, Battle Management, and Communications
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CEQ	Council on Environmental Quality
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
Cl	Atomic Chlorine
Cl_2	Molecular Chlorine
CM/CM	Critical Measurements and Countermeasures
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COIL	Chemical Oxygen Iodine Laser
COMSATCOM	Commercial Satellite Communications
CONOPS	Concept of Operations

CTF	Combined Test Force
dB	Decibel
dBA	A-weighted decibel
DNL	Day Night Average Noise Level
DoD	Department of Defense
DOT	Department of Transportation
DRMO	Defense Reutilization and Marketing Office
DSP	Defense Support Program
EA	Environmental Assessment
EIS	Environmental Impact Statement
EKV	Exoatmospheric Kill Vehicle
EM	Electromagnetic
EMR	Electromagnetic Radiation
EO	Executive Order
EPA	Environmental Protection Agency
ESA	European Space Agency
ESG	Engagement Sequence Group
ESQD	Explosive Safety Quantity Distance
ETR	Extended Test Range
EWR	Early Warning Radar
^oF	Degrees Fahrenheit
FAA	Federal Aviation Administration
FBX-T	Forward Based X-Band Radar Transportable
FL	Flight Level
FM	Flight Mission
FR	Federal Register
FTS	Flight Termination System
GBI	Ground-Based Interceptor
GBMC2	Ground-Based Midcourse Command and Control
GBR-P	Ground-Based Radar Prototype
GEO	Geosynchronous Earth Orbit
GHz	Gigahertz
GMD	Ground-Based Midcourse Defense
GT	Integrated Ground Test
H_2	Hydrogen
H_2O	Water
HAA	High Altitude Airship
HAIR	High Accuracy Instrumentation Radar
HALO	High Altitude Observatory
HAP	Hazardous Air Pollutant
HEL	High Energy Laser
HCl	Hydrogen Chloride
ICAO	International Civil Aviation Organization

ICBM	Inter-Continental Ballistic Missile
IDC	Initial Defensive Capability
IDLH	Immediately Dangerous to Life and Health
IDO	Initial Defensive Operations
IDOC	Initial Defensive Operations Capability
IDT	In-Flight Interceptor Communication System Data Terminal
IEEE	Institute of Electrical and Electronics Engineers
IFR	Instrument Flight Rules
IPSC	Interagency Perchlorate Steering Committee
IRFNA	Inhibited Red Fuming Nitric Acid
IRST	Infrared Search and Track
ISS	International Space Station
ISTEF	Innovative Science and Technology Experimentation Facility
KEI	Kinetic Energy Interceptor
KLC	Kodiak Launch Complex
LDC	Limited Defensive Capability
L_{eq}	Equivalent Noise Level
LEO	Low Earth Orbit
LHA	Launch Hazard Area
Lidar	Light Detection and Ranging
LOAEL	Lowest Observed Adverse Effect Level
LOS	Level of Service
MDA	Missile Defense Agency
MDIE	Missile Defense Integration Exercises
MEADS	Medium Extended Air Defense System
mg/m^3	Milligrams per cubic meter
mg/kg	Milligrams per kilogram
MHz	Megahertz
MOA	Military Operating Area
MPE	Maximum Permissible Exposure
MSL	Mean Sea Level
MSSS	Maui Space Surveillance System
MSX	Midcourse Space Experiment
N_2	Nitrogen
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NEXRAD	Next Generation Weather Radar
NIOSH	National Institute of Occupational Safety and Health
NFIRE	Near-Field Infrared Experiment
NMD	National Missile Defense
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides

NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries Service	NOAA National Marine Fisheries Service
NOI	Notice of Intent
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
OCONUS	Outside the Continental United States
OSHA	Occupational Safety and Health Administration
PAC-3	PATRIOT Advanced Capability-3
PAVE PAWS	Position and Velocity Extraction Phased Array Warning System
PEIS	Programmatic Environmental Impact Statement
PEL	Permissible Exposure Limit
ppm	parts per million
PM	Particulate Matter
PM_{10}	Particulate Matter with diameter 10 microns or less
$PM_{2.5}$	Particulate Matter with diameter 2.5 microns or less
PMRF	Pacific Missile Range Facility
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
ROD	Record of Decision
RTS	Ronald Reagan Ballistic Missile Defense Test Site
SBIRS	Space-Based Infrared Sensor
SBX	Sea-Based X-Band Radar
SDI	Strategic Defense Initiative
SDIO	Strategic Defense Initiative Organization
SIFT	System Integration Flight Test
SIP	State Implementation Plan
SM	Standard Missile
SO_2	Sulfur Dioxide
SO_X	Sulfur Oxides
SPCC	Spill Prevention, Control and Countermeasure
START	Reduction and Limitation of Strategic Offensive Arms Treaty
STEL	Short Term Exposure Limit
STSS	Space Tracking and Surveillance System
SWPPP	Storm Water Pollution Prevention Plan
THAAD	Terminal High Altitude Area Defense
TILL	Track Illuminator Laser
TLV	Threshold Limit Value
TMD	Theater Missile Defense
TOO	Target of Opportunity

TPS-X	Transportable System Radar
UCAR	University Corporation for Atmospheric Research
U.S.	United States
USAF	United States Air Force
USAKA	U.S. Army Kwajalein Atoll
USFWS	United States Fish and Wildlife Service
U.S.C.	United States Code
USGS	United States Geological Survey
USSR	Union of Soviet Socialist Republics
VFR	Visual Flight Rules
VOC	Volatile Organic Compound
WASP	Widebody Airborne Sensor Platform
WSMR	White Sands Missile Range
XBR	X-Band Radar

1 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1 Introduction

Pursuant to the National Environmental Policy Act (NEPA) of 1969 as amended (42 United States Code [U.S.C.] 4321, et seq.), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] 1500-1508), Department of Defense (DoD) Instruction 4715.9, *Environmental Planning and Analysis*, Presidential Executive Order (EO) 12114, Environmental Effects Abroad of Major Federal Actions, and the applicable DoD military service environmental regulations that implement these laws and regulations, all Federal agencies must consider the environmental consequences when planning for, authorizing, and approving Federal actions. Accordingly, the Missile Defense Agency (MDA) is preparing this Programmatic Environmental Impact Statement (PEIS) to examine the potential for impacts to the environment as a result of the development, test, deployment, and planning for decommissioning activities of an integrated Ballistic Missile Defense System (BMDS).

A PEIS analyzes actions that are broad in scope, occur in phases, and may be widely dispersed geographically. It also creates a comprehensive, global analytical framework that supports subsequent analysis of specific actions at specific locations within the overall system, i.e., tiering. Ranges, installations, and facilities at which specific test activities occur can develop more focused site-specific analyses that tier from this PEIS, thereby reducing analytical requirements and saving resources. This PEIS addresses the BMDS and the development and application of new technologies; evaluates the range of complex programs, architecture, and assets that comprise the BMDS; and provides the framework for future environmental analyses as activities evolve and mature. This PEIS supports the proposed integrated test schedule and considers BMDS deployment and decommissioning activities. This PEIS also considers the cumulative environmental effects that could result from the proposed action.

1.2 Background

In 1955, the United States (U.S.) began to study ways to protect against ballistic missile[1] attack. This study led to the development of the Nike-Zeus System, which accomplished the first successful intercept of a target Inter-Continental Ballistic Missile (ICBM) in 1962. Ten years later, the U.S. and the former Union of Soviet Socialist Republics (USSR) signed the Anti-Ballistic Missile (ABM) Treaty, which limited the development,

[1] A ballistic missile is a projectile traveling without its own power or guidance (like a bullet once it has been shot from a gun; the bullet travels a ballistic trajectory with only the forces of gravity and the atmosphere's friction acting on it).

testing, and deployment of ABM systems and components.[2] A 1974 amendment to the treaty further limited ABM defense deployment to one site at either an ICBM field or near the respective national capital. In 1975, the SAFEGUARD System, the only U.S. BMDS ever deployed, was activated in North Dakota. The SAFEGUARD System only operated until 1976, when it was deactivated.

In 1983, the Strategic Defense Initiative Organization (SDIO) was established within the DoD to manage and direct the research and testing of advanced technologies applicable to the development of a strategic missile defense system. These research and testing activities were known collectively as the Strategic Defense Initiative (SDI). Initially, the main purpose of SDI research concerned protecting the U.S. from weapons of mass destruction involving multiple ICBM strikes.

After the break up of the USSR and the conflict in the Persian Gulf in the early 1990's, the SDIO was refocused to emphasize protecting theater (i.e., outside the U.S.) operations and defending the U.S. against limited missile attacks (i.e., 200 warheads or less). In January 1991, President Bush described the need to acquire and deploy a Ballistic Missile Defense (BMD) system to protect not only the U.S. but also its forces overseas and its friends and allies. Subsequently, Congress provided guidance and direction to the DoD to redirect research and development for protection against ballistic missiles, regardless of their source, by enacting the Missile Defense Act.[3] In May 1993, the DoD reorganized the SDIO, renaming it the Ballistic Missile Defense Organization (BMDO).

In October 1993, the DoD completed the *Report on the Bottom-Up Review*, which reviewed the need for restructuring programs within the DoD. With respect to BMD, the review recommended the acquisition of a robust Theater Missile Defense (TMD) system[4], combined with the further development, but not the acquisition, of a more limited National Missile Defense (NMD) system. Accordingly, the DoD analyzed the proposed TMD system, its alternatives, and their potential environmental impacts in the 1993 *Final Theater Missile Defense Programmatic Life-Cycle Environmental Impact*

[2] MDA activities are in compliance with the Reduction and Limitation of Strategic Offensive Arms Treaty (START). Any mention of target ICBMs in this PEIS refers to decommissioned ICBMs.

[3] The Missile Defense Act enacted as part of the National Defense Authorization Act of 1992 (Public Law 92-190) established goals for theater and national missile defenses. It directed the DoD to develop a TMD system for possible deployment at an initial ABM Treaty-compliant site by 1996 or as soon as appropriate technology would allow. In July 1992, Secretary of Defense Cheney outlined a plan for the development and deployment of theater and national missile defenses. In passing the National Defense Authorization Act (Public Law 92-484) of 1993, Congress deleted the dates contained in the Act and in the conference report accompanying this Act; Congress endorsed a plan to deploy a limited NMD system by 2002.

[4] A theater missile is defined as "any missile (e.g., ballistic, cruise, or air-to-surface guided missile) directed against a target in an area of operations outside the U.S." (*Final Theater Missile Defense Programmatic Life cycle Environmental Impact Statement* 1993) The purpose of TMD is to "prevent or counter the launch of theater missiles against U.S. forces and allies, protect U.S. forces and allies from missiles launched against them, reduce the probability of and minimize the effects of damage caused by such an attack, and manage a coordinated response to a theater missile attack and integrate it with other combat operations."

Statement (TMD PEIS) and in the 1994 *Theater Missile Defense Extended Test Range Environmental Impact Statement* (TMD ETR EIS). The TMD PEIS included analysis of the environmental impacts of the research, development, and testing of TMD systems as well as the later life cycle phases of the system, such as production, basing, and decommissioning. The TMD ETR EIS included analysis of the environmental impacts of conducting extended-range TMD missile demonstration and operational test flights, target intercept tests, and sensor tests.

By 1994, the BMDO believed that the definition of an NMD system, as well as the technologies and resources required to implement the system, were sufficiently well understood to allow for a programmatic analysis of environmental impacts. Therefore, the BMDO issued a BMD PEIS that evaluated the environmental impacts of alternatives that would provide the U.S. the capability to produce and deploy an NMD system in the future. It further examined the cumulative environmental impacts of both the NMD and TMD systems.[5] Although the 1994 BMD PEIS ultimately selected the technology readiness (no action) alternative (i.e., the continuation of ongoing NMD activities and programs initiated under existing Congressional direction that were part of BMDO's technology readiness program) the BMD PEIS also analyzed several systems acquisition alternatives.[6] These alternatives, which involved more intensive research, development, and system-level testing as part of a program to acquire a specific defense system, included various combinations of ground-based and/or space-based elements (e.g., sensors, interceptors, and systems management tools).

Unlike the preferred technology readiness alternative, the system acquisition alternatives evaluated in the BMD PEIS had defined system architectures and descriptions of system acquisition life cycle phases. Thus, for those alternatives, the BMD PEIS evaluated potential environmental impacts of NMD activities beyond development and testing including: system production, fielding (deployment), operations and maintenance, and eventual decommissioning of facilities. The BMD PEIS programmatic analysis of the system acquisition alternatives would support “decisions on research, development, and testing activities” and thus would also serve “as the foundation from which future environmental documentation can be prepared, if needed.”

On February 16, 1996, the DoD completed another review of its BMD program. At that time, the DoD began an NMD Deployment Readiness program that would involve a shift

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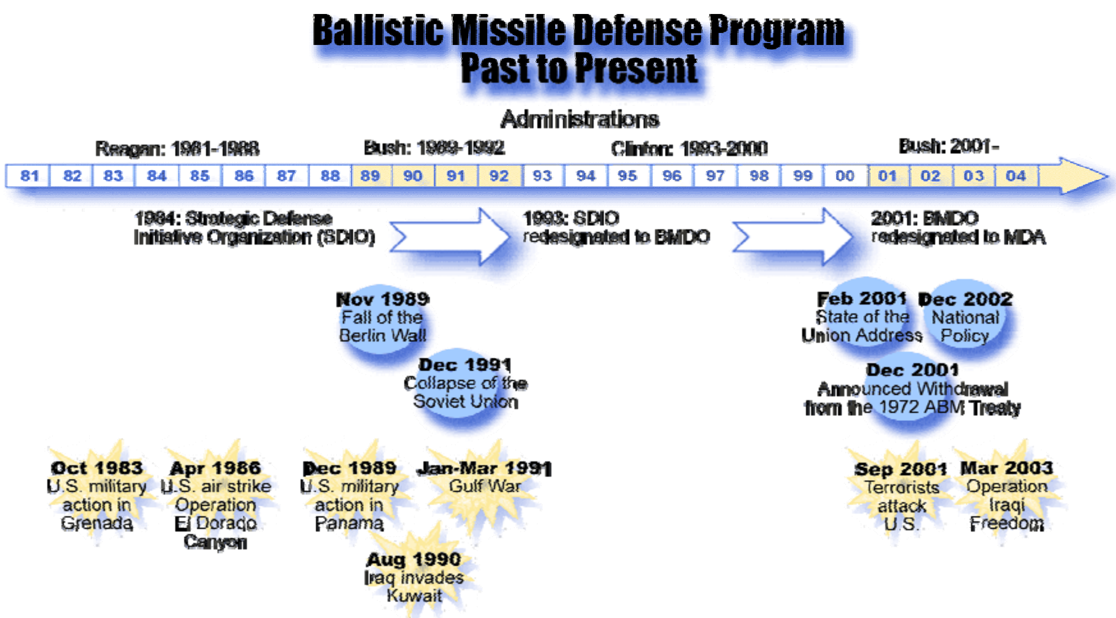
[5] The BMD PEIS focused more intensively on NMD because the DoD determined that the TMD program had independent utility and had already completed the TMD PEIS in 1993. The DoD incorporated the TMD PEIS by reference into the BMD PEIS, however, because the DoD intended TMD and NMD to operate as a multi-layered ballistic missile defense that would commit an appropriate interceptor, whether TMD or NMD, to defend against an attack. The BMD PEIS evaluated the combined effects of the TMD and NMD programs in a cumulative impacts analysis.

[6] Record of Decision (ROD) for the Final Programmatic Environmental Impact Statement (PEIS) for the BMD Program signed April 25, 1995.

from a technology readiness to a deployment readiness program, but without a decision to deploy an NMD system at that time. Therefore, DoD adopted a "3 plus 3" program for NMD, which would have enabled the U.S. to develop, within three years, elements of an initial NMD system that could be deployed within three years of a deployment decision. The DoD expected an NMD three-year development phase, which commenced in 1997, to culminate in a deployment readiness review in the year 2000, at which time the DoD would have decided whether to begin a three-year program to deploy an NMD system. An overview of the major events in the BMDS timeline is depicted in Exhibit 1-1.

Exhibit 1-1. Ballistic Missile Defense Timeline



On July 15, 1998, the "Commission to Assess the Ballistic Missile Threat to the United States"[7] issued a report to Congress. The report unanimously concluded that there had been concerted efforts by a number of overtly or potentially hostile nations (including North Korea, Iran, and Iraq) to acquire ballistic missiles with biological or nuclear payloads, posing a growing threat to the U.S. The report concluded that these nations would be able to inflict major destruction on the U.S. within approximately five years of a decision to acquire such a capability (10 years in the case of Iraq). The report also concluded that the threat to the U.S. posed by these emerging capabilities was broader, more mature, and evolving more rapidly than had been reported in estimates and reports by the Intelligence Community and that ultimately, the U.S. might have little or no

[7] The Commission's mandate was to "assess the nature and magnitude of the existing and emerging powers to arm ballistic missile with weapons of mass destruction." Members of the Commission were nominated by Congressional leaders and appointed by the Director of the Central Intelligence Agency.

warning before operational deployment.[8] For these reasons, the Commission unanimously recommended that "the analyses, practices, and policies" of the U.S. "that depend on expectations of extended warning of deployment be reviewed and, as appropriate, revised to reflect the reality of an environment in which there may be little or no warning."

On November 17, 1998, the BMDO published in the *Federal Register* (FR) a Notice of Intent (NOI) "to prepare an EIS for a potential NMD deployment, should the U.S. Government make such a decision."[9] The BMDO, in July 2000, issued the final Environmental Impact Statement (EIS) for NMD deployment. The proposed action identified in the final EIS was a decision to deploy and operate an NMD system consisting of five elements, including: 1) ground-based interceptors (GBIs)[10]; 2) Battle Management/Command and Control (BMC2)[11]; 3) an X-band radar (XBR)[12]; 4) an upgraded early warning radar (EWR)[13]; and 5) space-based satellite detection systems.[14] The final NMD Deployment EIS further specified that as part of a program to deploy an NMD system, a "Test, Training, and Exercise Capability" would be implemented.

In October 1999, while the draft NMD Deployment EIS was being circulated for public comment, the BMDO successfully completed its first test involving a planned intercept of

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[8] The Commission's report also unanimously determined that the Intelligence Community's ability to provide timely and accurate estimates of ballistic missile threats was eroding and that the warning times the U.S could expect for new, threatening ballistic missile deployments were decreasing.

[9] 63 FR 63915 (1998). In the notice, the BMDO identified the technological elements of the NMD system that would be analyzed in the EIS and stated

> "The decision to be made is whether to deploy such a system. This decision will be based on an analysis of the potential limited strategic ballistic missile threat to the U.S. from a rogue nation, technical readiness of the NMD system for deployment, and other factors including potential environmental impacts. If the decision is to deploy, then sites would be selected from the range of locations studied in the EIS. The EIS will provide the U.S. Government with the information necessary to properly account for the environmental impacts of this decision."

As the BMDO further explained

> "[s]hould the deployment options not be exercised in the year 2000, improvements in NMD system element technology would continue, while an ability to deploy a system within three years of a decision would be maintained."

[10] The GBI's mission is to intercept incoming ballistic missile warheads outside the Earth's atmosphere (exoatmospheric) and destroy them by the force of the impact alone, i.e., without explosives or nuclear warheads. The GBI element includes the interceptor (i.e., missile), kill vehicle, and associated launch and support equipment, silos, facilities, and personnel.

[11] BMC2 is a sub-component of Command, Control, Battle Management and Communications (C2BMC) that supplies the means to plan, select, and adjust missions and courses of action.

[12] The XBRs would be ground-based, multi-function radars that, for NMD purposes, would perform tracking, discrimination, and kill assessments of incoming ballistic missile warheads.

[13] Early warning phased-array surveillance radars, for example, "Position and Velocity Extraction Phased Array Warning System (PAVE PAWS)," are used to detect, track, and provide early warning of sea-launched ballistic missiles. These radars also are used to track satellites and space debris.

[14] Existing DoD satellites provide the U.S. early warning satellite capability. These satellites are comparatively simple, inertially fixed, geosynchronous earth orbit (GEO) satellites with an unalterable scan pattern.

an ICBM.[15] The test demonstrated "hit-to-kill technology" to intercept and destroy the ballistic missile target. The next two tests, which were conducted in January 2000 and July 2000, respectively, did not result in an intercept.

On September 1, 2000, President Clinton announced that, due to technical uncertainties, unsuccessful flight tests, and concerns about potential implications for the ABM Treaty, he would not authorize deployment of an NMD system but would leave that decision to his successor.[16] In the interim, President Clinton stated the DoD would continue developing and testing radars and interceptors that would defend the U.S. against incoming ballistic missiles.

In early 2001 with the election of George W. Bush as President, the BMDO began to expand the test infrastructure to support greater realism in the test program and restructured the development approach into one that adopted spiral development of technologies and capabilities in coherent, incremental blocks.[17] Elements of the BMDO began development of a "test bed" in the Pacific to support this effort.[18]

Because the ABM Treaty limited the development, testing, and development of ballistic missile defense capabilities, President Bush gave Russia formal notice on December 13, 2001 that the U.S. would withdraw from the ABM Treaty in six months. On January 2, 2002, Secretary of Defense Rumsfeld issued a directive to the DoD to establish a single development program for all the work needed to design, develop, and test elements of an integrated BMDS that would operate under a newly titled MDA.[19]

To support test bed activities, MDA completed the *Ground-Based Midcourse Defense Validation of Operational Concept Environmental Assessment* (GMD Validation of

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[15] Exoatmospheric Reentry Vehicle Interceptor System Environmental Assessment (EA), 1987, analyzed the launch of a Minuteman target from Vandenberg Air Force Base (AFB) and the launch of a GBI from the Ronald Reagan Ballistic Missile Defense Test Site (RTS), Kwajalein Atoll.

[16] On May 20, 1999 Congress passed the National Missile Defense Act to "deploy as soon as is technologically possible an effective NMD system..."

[17] "Spiral development" is an iterative process for developing the BMDS by refining program objectives as technology becomes available through research and testing with continuous feedback between MDA, the test community, and military operators. Thus, MDA can consider deployment of a missile defense system that has no specified final architecture and no set of operational requirements, but which will be improved incrementally over time. Blocks are synchronized sets of capability developments that can be added to the BMDS, build on previous blocks, and will be verified prior to transfer to the military services.

[18] "Test bed" is defined as a collection of integrated BMD element development hardware, software, prototypes, and surrogates, as well as supporting test infrastructure (e.g., instrumentation, safety/telemetry systems, and launch facilities) configured to support realistic development and testing of the BMDS.

[19] The MDA's mission is to develop, test and prepare for deployment a missile defense system. Using complementary interceptors; land-, sea-, air-, and space-based sensors; and battle management, command and control, and communications systems, the planned missile defense system will be able to engage and negate all classes and ranges of ballistic missile threats. The Secretary directed that MDA "employ a BMDS that layers defenses to intercept missiles in all phases of their flight (i.e., boost, midcourse, and terminal) against all ranges of threats."

Operational Concept EA) to construct test bed assets at Fort Greely, Alaska and at other supporting Alaska locations.[20] The GMD Validation of Operational Concept EA primarily examined ground activities regarding the construction of six GBI silos and support facilities to validate the operational concept of the test bed. The GMD Validation of Operational Concept Supplemental EA further analyzed additional infrastructure requirements necessary to support validation of the test bed operational concept.[21]

In July 2003, MDA completed the *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement* (GMD ETR EIS), which provided for the construction and operation of additional launch and communication facilities in the Pacific test bed, and for development and operation of a sea-based X-band radar (SBX).[22]

Following continued test bed development and successful flight test activities, President Bush decided to provide the nation with an operational missile defense capability. On December 17, 2002, the President announced his decision to field an initial defensive operation (IDO) capability.[23] The initial fielding would provide a modest protection of the U.S. and would be improved over time. In view of this decision, MDA issued a Record of Decision (ROD) from the 2000 NMD Deployment EIS to support the fielding of up to 40 GBI silos at Fort Greely, Alaska.[24] In addition, the IDO capability would include four silos at Vandenberg Air Force Base (AFB). This latter action was addressed in the *Environmental Assessment for GMD Initial Defensive Operations Capability (IDOC) at Vandenberg Air Force Base (AFB).*[25]

Prior to initiation of this PEIS, MDA and its predecessor agencies prepared several programmatic NEPA documents regarding ballistic missile defense.[26] In addition, each program element prepared extensive NEPA documentation to cover its own specific, tiered documents. Ballistic missile defense has again evolved to the point that this programmatic EIS is being prepared to consider the coordinated BMDS as envisioned by the January 2002 creation of the MDA.

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[20] The GMD Validation of Operational Concept EA Finding of No Significant Impact was signed in April 2002.
[21] The GMD Validation of Operational Concep*t* Supplemental EA Finding of No Significant Impact was signed in January 2003.
[22] The GMD ETR EIS addressed dual GBI and target capabilities at Vandenberg AFB, the RTS, Kwajalein Atoll, and the Kodiak Launch Complex (KLC) in Kodiak, Alaska. It further addressed necessary infrastructure in the Pacific to support these capabilities. There have been two RODs for actions analyzed in this EIS: 1) *ROD to Establish a GMD ETR*, dated August 2003, and 2) *Supplemental ROD to Conduct Target Launches from Kodiak Launch Complex in Support of GMD ETR,* dated November 2003.
[23] In October 2004, MDA achieved a limited missile defensive capability (LDC) when certain BMDS test components could also be placed on alert and used in defensive operations. As decisions are made based on technical performance, maturity, military utility, and national security, assets may be "placed on alert" as operational defensive capabilities. These defensive capabilities may initially be limited but could become more robust as more capability is developed or acquired.
[24] The *ROD To Establish a GMD Initial Defensive Operations Capability (IDOC) at Fort Greely, Alaska*, was finalized April 2003.
[25] The GMD IDO Capability at Vandenberg AFB Finding of No Significant Impact was signed in October 2003.
[26] The most recent programmatic documents were the 1993 TMD PEIS and the 1994 BMD PEIS.

1.3 Purpose of the Proposed Action

The purpose of the proposed action is to incrementally develop and deploy a BMDS, the performance of which can be improved over time, that layers defenses to intercept ballistic missiles of all ranges in all phases of flight.

1.4 Need for the Proposed Action

The proposed action is needed to protect the U.S., its deployed forces, friends and allies from ballistic missile threats.

In 1972, only eight countries had ballistic missiles; today there are over 30 and the threat is pervasive and proliferating. The U.S. national policy for addressing the threat of ballistic missiles and weapons of mass destruction includes a dual-path approach of both diplomatic and military measures. Diplomatically, the U.S. tries to assure our allies that we will be a dependable and strong partner for our collective security and also to dissuade or prevent potential adversaries from acquiring or developing ballistic missiles and related technologies altogether. The second path would require a non-offensive, BMDS that would protect the U.S. and its friends and allies from short-, medium-, and long-range threats.

1.5 The Proposed Action

The MDA proposes to develop, test, deploy and to plan for related decommissioning activities for an integrated BMDS using existing infrastructure and capabilities, when feasible, as well as emerging and new technologies, to meet current and evolving threats from ballistic missiles. The Secretary of Defense assigned the MDA the mission to develop and field an integrated BMDS capable of providing a layered defense for the homeland, deployed forces, friends, and allies against ballistic missiles of all ranges in all phases of flight.

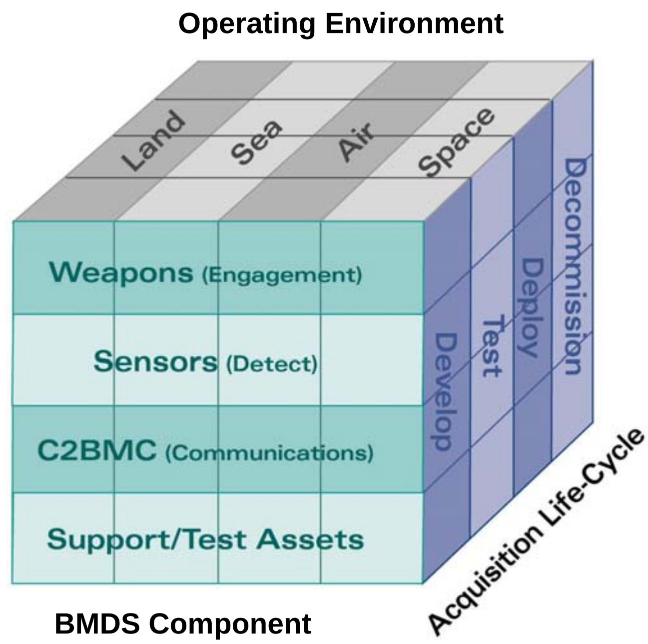
1.6 Scope of the Programmatic Environmental Impact Statement

This PEIS identifies, evaluates and documents, at the programmatic level, the potential environmental effects of the development, testing, and deployment of a BMDS, along with planning for its eventual decommissioning. Although there is already extensive environmental analysis for many of the existing and projected components of the proposed BMDS, this PEIS examines potential environmental impacts of MDA's concept for developing an integrated BMDS, based on current Congressional and Presidential direction. The BMDS PEIS will provide the framework for analyzing the development, testing and deployment of the range of complex components, architectures, and assets comprising the proposed BMDS, as well as planning for their decommissioning. The BMDS PEIS considers cumulative environmental effects that could result from the

proposed action at an appropriate programmatic level. This framework also will provide a basis from which to tier environmental impact analyses for future MDA activities.

This PEIS will address the life cycle of the proposed BMDS and its components from original research and development through planning for decommissioning. Conceptually, the BMDS is envisioned to be a layered system of weapons (i.e., interceptors and lasers), sensors (i.e., radars, infrared, optical and lasers), Command and Control, Battle Management, and Communications (C2BMC), and support assets (i.e., equipment, infrastructure and test assets), each with specific functional capabilities, working together to defend against all classes and ranges of threat ballistic missiles in the boost, midcourse, and terminal flight phases. Exhibit 1-2 depicts the multi-dimensional complexities

Exhibit 1-2. Complexities of the BMDS



involved in considering the impacts of implementing an integrated BMDS in terms of its components, acquisition life cycle activities, and operating environments.

There currently are no final or fixed architecture and no set operational requirements for the proposed BMDS. Instead, development, demonstration, and deployment of the integrated BMDS would occur over several years in an evolutionary, spiral development process designed to field an initial capability in 2004-2005 and gradually replace, enhance, or supplement this with layers of increasingly capable weapons and sensors, made possible by emerging technologies. Each new technology would go through development; promising technologies would go through testing and demonstration; and proven technologies would be incorporated into the BMDS.

Development includes the various activities that would support research and development of the BMDS components and the overall system. Development activities would include planning, budgeting, research and development, systems engineering, site preparation and construction, maintenance and sustainment, manufacture of test articles (prototypes) and initial testing, and tabletop exercises. Tabletop exercises would be used to develop and improve the Operations Concepts, the broad outline or overall picture of BMDS operations. This PEIS addresses technologies that currently are in the development stage and provides a framework for evaluating new technologies that may be developed in the future.

Testing of the BMDS involves demonstration of BMDS components through test and evaluation. The successful demonstration of the BMDS would rely on a complex testing program aimed at producing credible test data for system characterization, verification, and assessment. To confirm these capabilities, MDA would continue to develop a Test Bed using existing and new land-, sea-, air- and space-based assets. Some construction at various geographic locations would be required to support infrastructure and assets where BMDS components and the overall system would be tested. The BMDS PEIS includes ongoing and planned tests (e.g., ground tests [GTs] and flight tests) of components that might be incorporated into the BMDS, as well as tests of the layered, integrated BMDS through increasingly complex System Integration Tests including system integration flight tests (SIFTs) through 2010 and beyond.

Deployment of the BMDS refers to the fielding (including the manufacture, site preparation, construction and transport of systems) and sustainment (operations and maintenance, training, upgrades, and service life extension) of BMDS architecture. The evolving BMDS is intended to have the capability over time to deploy different combinations of interoperable sensor suites, weapons, and C2BMC. After production, some BMDS components would be transported to deployment locations. Deployment also would involve the transfer of facilities, elements, and programs to the military services. The BMDS PEIS includes start up and ongoing operations and maintenance activities that would be required at the facility locations. For some technologies and fixed assets, such as large radars, proposed deployment locations can be identified. For other technologies, such as mobile launchers and the Airborne Laser (ABL), potential deployment locations can be anticipated only in a general sense, as actual deployment decisions would depend on future geopolitical conditions and security concerns. Although the operational life of some BMDS technologies can be estimated, it is difficult to estimate for many proposed technologies given both the uncertainty of their development and deployment schedules as well as the potential for technology upgrades and service life extensions.

Decommissioning would involve the demilitarization and final removal and disposal of the BMDS components and assets. Plans would be made for decommissioning BMDS components by either demolition or transfer to other uses or owners.

Typical activities involved in developing, testing, deploying and planning for decommissioning the proposed BMDS are identified in Exhibit 1-3.

Exhibit 1-3. Typical Activities for BMDS Proposed Action

Life Cycle Phase	Components	Typical Activities
Development	**Weapons - Laser** **Weapons - Interceptor** **Sensors** **C2BMC** **Support Assets - Equipment** **Support Assets - Infrastructure** **Support Assets - Test Assets**	Planning/Budgeting
		Research and Development
		Systems Engineering
		Site Preparation and Construction
		Maintenance or Sustainment
		Manufacturing of Prototypes
		Testing of Component Prototypes
		Tabletop Exercises
Testing*	**Weapons - Laser**	Manufacturing
		Site Preparation and Construction
		Transportation
		Activation
	Weapons - Interceptor	Manufacturing
		Site Preparation and Construction
		Transportation
		Prelaunch
		Launch/Flight
		Postlaunch
	Sensors	Manufacturing
		Site Preparation and Construction
		Transportation
		Activation
	C2BMC	Manufacturing
		Site Preparation and Construction
		Transportation
		Activation
	Support Assets - Equipment	Manufacturing
		Operational Changes
		Site Preparation and Construction
		Transportation
	Support Assets - Infrastructure	Site Preparation and Construction
	Support Assets - Test Assets	Manufacturing
		Site Preparation and Construction
		Transportation

Exhibit 1-3. Typical Activities for BMDS Proposed Action

Life Cycle Phase	Components	Typical Activities
		Activation
		Prelaunch
		Launch/Flight
		Use of Countermeasures, Simulants, or Drones
		Postlaunch
Deployment	**Weapons - Laser** **Weapons - Interceptor** **Sensors** **C2BMC** **Support Assets - Equipment** **Support Assets - Infrastructure** **Support Assets - Test Assets**	Manufacturing
		Site Preparation and Construction
		Transportation
		Prelaunch
		Launch/Flight
		Postlaunch
		Activation
		Maintenance or Sustainment
		Upgrades
		Training
		Use of Human Services
		Service Life Extension
Decommissioning	**Weapons - Laser** **Weapons - Interceptor** **Sensors** **C2BMC** **Support Assets - Equipment** **Support Assets - Infrastructure** **Support Assets - Test Assets**	Demilitarization
		Disposal

*Includes System Integration Testing that includes integrated GTs as well as system integration flight tests (SIFTs) with a single weapon with single intercept scenario and a multiple weapons with multiple intercepts scenario.

1.7 Consultations and Coordination

As the lead agency, MDA has primary responsibility for preparing the PEIS. As part of the scoping process, the lead agency is required to consult with affected Federal, state, local, and tribal agencies, and other interested parties. A continuing relationship with affected and interested entities can be established to promote cooperation and resolution of mutual land-use and environment-related problems, and to promote the concept of

regional ecosystem management as well as general cooperative problem solving. The agencies involved in this process are referred to as coordinating or consulting agencies.

Consulting agencies do not enter into a legal agreement with the lead agency. Consulting agencies may submit comments and provide data to support the environmental analysis, but they do not participate in the internal review of documents, issues, and analyses. A consulting agency does not participate directly in the development of technical analyses and conclusions.

The MDA has identified several agencies that may be coordinating or consulting agencies for this PEIS. These agencies include: National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries Service), the Advisory Council on Historic Preservation (ACHP), U.S. Fish and Wildlife Service, and the U.S. Federal Aviation Administration (FAA).

A cooperating agency is any Federal agency, other than a lead agency, that has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment. (40 CFR Part 1508.5) The MDA has held informal meetings with several agencies; however, MDA has not requested that any agencies participate as cooperating agencies for this PEIS. See Appendix A for additional information on consultation and coordination.

1.8 Summary of the Public Involvement Process

The MDA provided several opportunities and means for public involvement during scoping and throughout the preparation of the BMDS PEIS. The CEQ implementing regulations for NEPA describe the public involvement requirements for agencies (40 CFR 1506.6). Public participation in the NEPA process not only provides for and encourages open communication between the MDA and the public, but also promotes better decision-making. Throughout the preparation and review of the Draft BMDS PEIS, the MDA aimed to obtain meaningful input concerning the issues that should be addressed.

1.8.1 Scoping

Scoping for the development of the BMDS PEIS began with the publication of the NOI in the FR (68 FR 17784) on April 11, 2003. See Appendix B for a detailed description of scoping and a copy of the NOI. During scoping, the MDA invited the participation of Federal, state, and local agencies, Native American Tribes, environmental groups, organizations, citizens, and other interested parties to assist in determining the scope and significant issues to be evaluated in the BMDS PEIS. The MDA developed a web site, http://www.mda.mil/mdalink/html/mdalink.html, to provide information on the BMDS PEIS and to solicit scoping comments. The MDA also established toll-free phone and

fax lines, an e-mail address, and a U.S. postal service mailbox for submittal of public comments and questions.

MDA held public scoping meetings in accordance with CEQ regulations. (40 CFR 1501.7) Meetings took place in Arlington, Virginia on April 30, 2003; Sacramento, California on May 6, 2003; Anchorage, Alaska on May 8, 2003; and Honolulu, Hawaii on May 13, 2003. The purpose of the scoping meetings was to request input from the public on concerns regarding the proposed activities as well as to gather information and knowledge of issues relevant to analyzing the environmental impacts of the BMDS. The public scoping meetings also provided the public with an opportunity to learn more about the MDA's proposed action and alternatives. In addition to announcing the public scoping meetings in the NOI, the MDA placed legal notices in local and regional newspapers and notified state governors, mayors, members of Congress and local media representatives about the scoping meetings. See Appendix B for additional information on public involvement.

During scoping, the MDA received 285 comments. The MDA requested scoping comments be submitted by June 12, 2003, to be considered in developing the Draft BMDS PEIS. The majority of comments were related to opposition to the BMDS, especially with regard to the use of space as a weapons platform; concern that the program would bankrupt the economy and that Federal funds should be channeled to address socioeconomic problems, better health care and insurance coverage, and education; and concern that the BMDS would create an arms race, especially in space. Other key issues included opposition to development of nuclear weapons and concern that missile defense could be a first strike capability for U.S. worldwide military domination. Public comments concerning DoD policy, budget, and program issues are outside the scope of the Draft BMDS PEIS. Comments received pertaining to reasonable alternatives to the proposed action, resource areas, human health, and environmental impacts were considered in this BMDS PEIS. See Appendix B for comment excerpts related to resource areas and human health and environmental impacts.

1.8.2 Public Comment Period

The public comment period began with the publication of the Notice of Availability (NOA), published in the FR by the Environmental Protection Agency (EPA) on September 17, 2004. The NOA announced the availability of the Draft PEIS, initiated the public comment period for the NEPA process, and requested comments on the Draft PEIS. The MDA also published a NOA in the FR on September 17, 2004, which provided information on the proposed action and alternatives, listed the dates and locations of the public hearings, and provided contact information for submitting comments to the MDA. See Appendix B for a detailed description of the public comment period and a copy of the NOA.

A downloadable version of the Draft PEIS was available on the BMDS PEIS web site and hardcopies of the document were placed in the following public libraries:

- Anchorage Municipal Library, 3600 Denali Street, Anchorage, AK 99503
- Mountain View Branch Library, 150 South Bragaw Street, Anchorage, AK 99508
- California State Library, Library and Courts Building, 914 Capital Mall, Sacramento, CA 95814
- Sacramento Public Library, 828 I Street, Sacramento, CA 95814
- Hawaii State Library, Hawaii Documents Center, 478 South King Street, Honolulu, HI 96813
- University of Hawaii at Manoa, Hamilton Library, 2550 The Mall, Honolulu, HI 96822
- Arlington County Public Library, Central Branch, 1015 North Quincy Street, Arlington, VA 22201
- District of Columbia Public Library, Central Branch – Martin Luther King, Jr. Memorial Library, 901 G Street, NW, Washington, DC 20001

MDA held public hearings in Arlington, Virginia on October 14, 2004; Sacramento, California on October 19, 2004; Anchorage, Alaska on October 21, 2004; and Honolulu, Hawaii on October 26, 2004. In addition to announcing the public hearings in the NOA, the MDA placed legal notices in local and regional newspapers and notified state governors, mayors, and members of Congress. See Appendix B for additional information on the public hearing notification process.

The purpose of the public hearings was to solicit comments on the environmental areas analyzed and considered in the Draft PEIS. Appendix B contains a reproduction of the transcripts of the public hearings.

During the public review period, the MDA received approximately 8,500 comments on the Draft PEIS. See Appendix K for an overview of comments received on the Draft PEIS and the MDA's responses to in-scope comments. Additional areas of analysis—orbital debris, perchlorate, and radar impacts to wildlife—are addressed in more technical detail in Appendices L, M, and N, respectively.

1.9 Related Documentation

Existing relevant NEPA analysis and health and safety documentation is incorporated by reference. These documents are listed in Appendix C, Related Documentation. The relevant information and analyses contained in these documents is summarized in this PEIS where appropriate.

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2 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

The proposed action is to develop, test, deploy, and to plan for decommissioning activities for an integrated BMDS using existing infrastructure and capabilities, when feasible, as well as emerging and new technologies, to meet current and evolving threats in support of the MDA's mission.

2.1 BMDS Concept

The BMDS is designed to negate threat ballistic missiles of all ranges in all phases of flight. To achieve this mission, the BMDS would be made up of **components** (i.e., weapons; sensors; C2BMC; and support assets). These components would be

> ***Component***: Subsystem, assembly, or subassembly of logically grouped hardware and software, that performs interacting tasks to provide BMDS capability at a functional level.

assembled into programs known as **elements**, which can operate independently or together to defeat a threat missile.

> ***Element:*** A functional set of integrated components comprising a stand-alone defensive capability**.** The elements provide "blueprints" for some of the specific functional capabilities that would be included in the proposed BMDS. However, the configuration of these elements is dependent upon the ongoing testing and enhancement of their components.

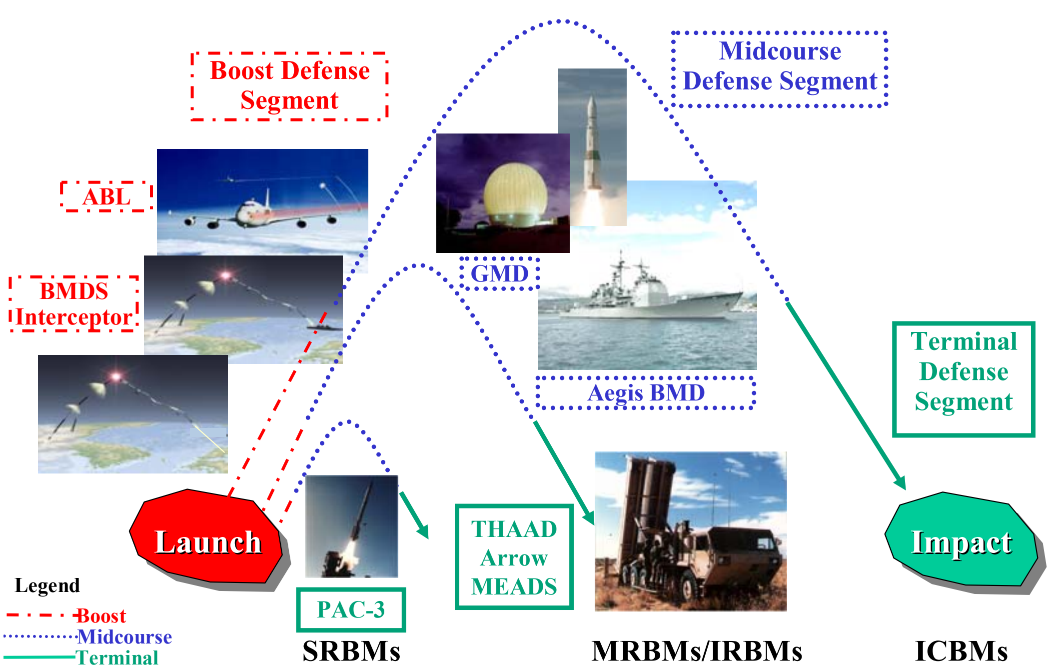
Multiple defensive weapons are required to create a layered defense comprised of multiple intercept or shot opportunities along the incoming threat missile's trajectory. These weapons would be used from a variety of platforms (i.e., any military structure or vehicle bearing weapons). This layered defense would provide a defensive system of capabilities that could back up one another. For example, one element could engage a threat missile in its boost phase and other elements could be used to intercept the threat missile in later phases if initial intercept attempts were unsuccessful. As shown in Exhibit 2-1, ballistic missiles can be categorized based on their approximate flight distances.

Exhibit 2-1. Types and Maximum Ranges of Ballistic Missiles

Type of Ballistic Missile	Approximate Flight Distance in kilometers (miles)
Short Range Ballistic Missile	600 (373)
Medium Range Ballistic Missile	1,300 (808)
Intermediate Range Ballistic Missile	5,500 (3,418)
Inter-Continental Ballistic Missile (ICBM)	10,000 (6,214)

Each type of ballistic missile has three distinct phases of flight: boost, midcourse, and terminal. A flight phase is a portion of the path followed by an object moving through the atmosphere or space. Each phase of flight presents its own challenges to a defensive intercept due to variations in speed, configuration, altitude, and range. The proposed BMDS is envisioned to be capable of defending against all classes of threat ballistic missiles in all phases of flight. Exhibit 2-2 presents missile flight phases also defined as defense segments with the existing BMDS elements designed to operate in them. Please refer to the legend on Exhibit 2-2 to identify the elements that are in the various flight phases or defense segments.

Exhibit 2-2. Ballistic Missile Flight Phases and Defense Segments



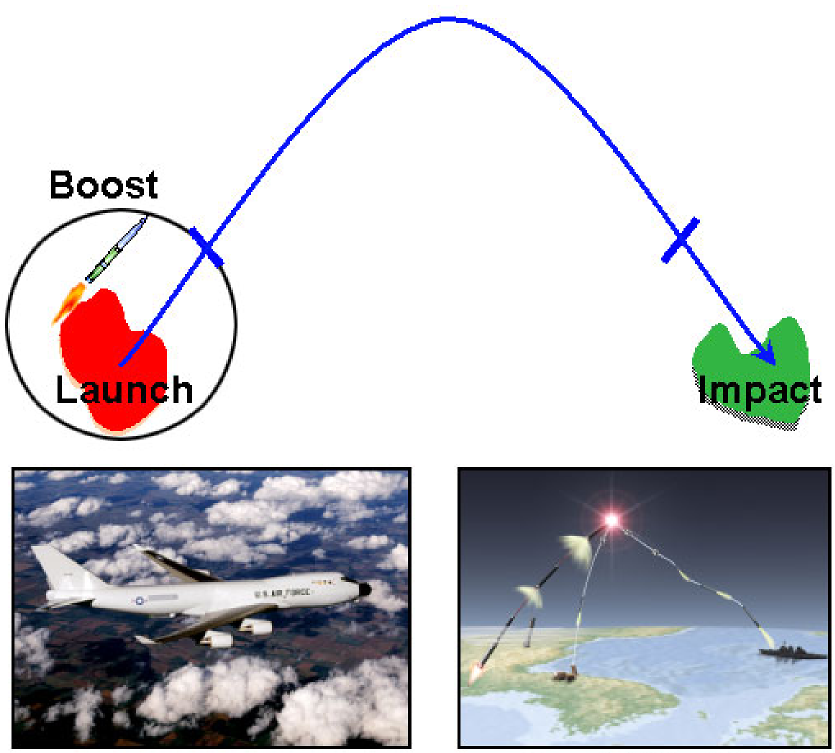
The following section describes each of the three phases of ballistic missile flight, and the currently configured or planned program elements within the BMDS that are designed to address the threat missile within that phase. An overview of the program elements is provided in Appendix D.

2.1.1 BMDS Layered Defense and Missile Flight Phases

2.1.1.1 Boost Phase and the Boost Defense Segment

The ***Boost Phase*** (see Exhibit 2-3) is the first phase of a ballistic missile trajectory, when the rocket engine is ignited and the missile is lifting off and setting out on a specific path. The missile is powered by its engines throughout this phase.

Exhibit 2-3. Boost Phase and the Boost Defense Segment



Airborne Laser

Terrestrial Test Bed
Kinetic Energy Interceptor

- Ballistic missiles are most vulnerable during boost – relatively easy to find and moving slowly
- BMDS needs to be alerted and positioned near the enemy launch site to engage in boost phase
- Requires quick reaction times, high confidence decision making, and multiple engagement capabilities
- Missile is within Earth's atmosphere (endoatmosphere)
- Boost phase lasts about 180 to 600 seconds
- Key elements: ABL and Kinetic Energy Interceptor (KEI)

Currently configured or planned BMDS elements in the boost defense segment include

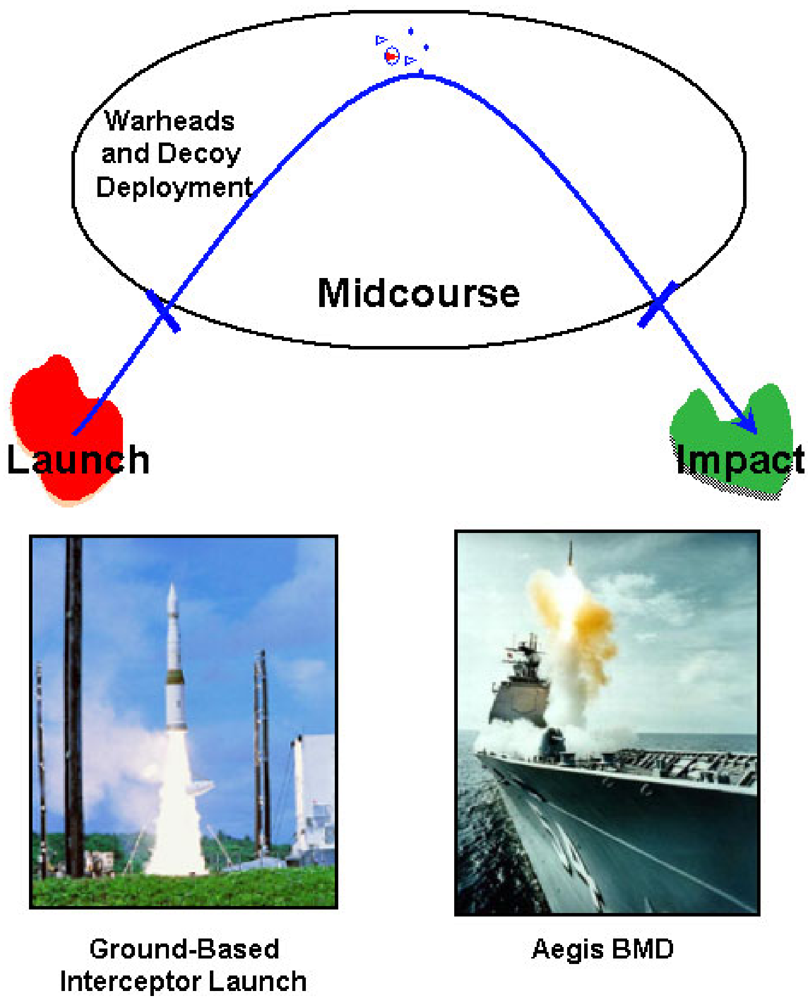
Airborne Laser (ABL). The ABL involves putting a weapons class laser aboard a modified Boeing 747 aircraft and using that laser to destroy enemy ballistic missiles in the boost phase.

Kinetic Energy Interceptor (KEI or BMDS Interceptor). The primary objective of the KEI or BMDS Interceptor program is to develop an interceptor capable of destroying ICBMs in the boost phase.

2.1.1.2 Midcourse Phase and the Midcourse Defense Segment

The *Midcourse Phase* (see Exhibit 2-4) begins when the rocket engine cuts off and the threat missile travels a ballistic trajectory. During this phase, the threat missile is approximately 100 kilometers (62 miles) above Earth's surface. At this point it could deploy decoys to confuse detection and discrimination systems and/or a warhead that continues on the missile's trajectory towards its target.

Exhibit 2-4. Midcourse Phase and the Midcourse Defense Segment



- Ballistic missiles "coast" for several minutes during midcourse and may deploy warheads and decoys
- BMDS uses multiple sensors to determine "real" threat and directs weapons to destroy threat objects in space
- Threat missile is about 100 kilometers above the Earth's surface (exoatmosphere)
- Midcourse phase lasts about 1200 seconds
- Key elements: Ground-Based Midcourse (GMD) and Aegis BMD

BMDS elements currently configured to comprise the midcourse defense segment include

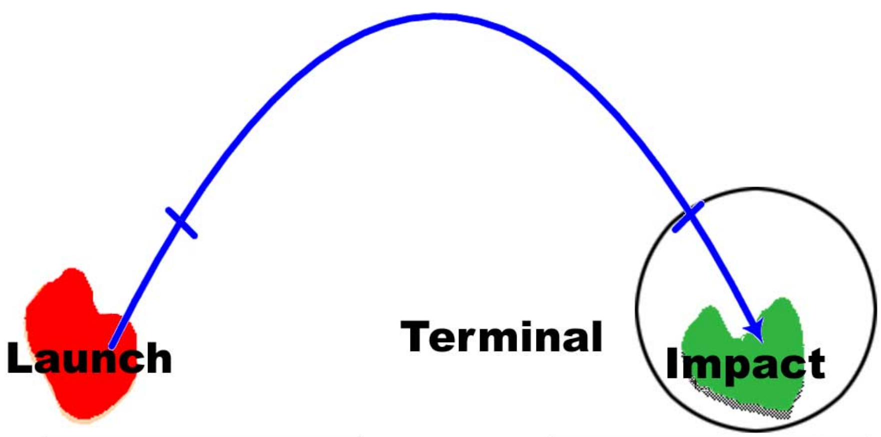
Ground-Based Midcourse Defense (GMD). The GMD mission is to defend against long-range ballistic missile attacks, using its weapon, the GBI, to defeat threat missiles during the midcourse segment of flight.

Aegis Ballistic Missile Defense (Aegis BMD). The Aegis BMD will provide the capability for Navy Aegis cruisers to use hit-to-kill technology to intercept and destroy short- and medium-range ballistic missiles.

2.1.1.3 Terminal Phase and the Terminal Defense Segment

The ***Terminal Phase*** (see Exhibit 2-5) begins as the deployed warhead or the missile continues along its ballistic trajectory towards trajectory termination.

Exhibit 2-5. Terminal Phase and the Terminal Defense Segment



Terminal High Altitude Area Defense (THAAD) Launch

PATRIOT Advanced Capability (PAC)-3

- Ballistic missile is seconds away from its intended target as it approaches trajectory termination
- BMDS “last line of defense” - defensive systems must be positioned near area to be protected (e.g., city, airfield)
- Terminal phase lasts about 30 seconds
- Key elements: PATRIOT Advanced Capability – 3 (PAC-3), Terminal High Altitude Area Defense (THAAD), Israeli Arrow Weapon System, Multi-national Medium Extended Air Defense System (MEADS)

BMDS elements currently configured or planned for the terminal defense segment include

PATRIOT Advanced Capability-3 (PAC-3). PAC-3 is a mobile and transportable land-based missile defense element that is capable of multiple simultaneous engagements of short- and medium-range ballistic missiles and can operate in electronic countermeasure environments.

Terminal High Altitude Area Defense (THAAD). THAAD is designed to destroy a ballistic missile as it transitions from the mid-course to terminal phase of its trajectory both inside and outside of the atmosphere (in the endo- or exoatmosphere). THAAD is a land-based element that has the capability to shoot down a short- or medium-range ballistic missile and has rapid mobility to provide a means of defense anywhere in the world in a short timeframe.

Arrow Weapon System (AWS). The AWS is a cooperative effort between the U.S. and the Government of Israel to develop a missile defense system to protect the State of Israel and U.S. and allied forces deployed in the Middle East Region. The AWS is a ground-based missile defense system capable of tracking and destroying multiple short- and medium-range ballistic missiles in the terminal phase of their flight.

Medium Extended Air Defense System (MEADS). The MEADS program is a transatlantic cooperative effort between the U.S., Germany, and Italy to develop an air and missile defense system that is strategically transportable and tactically mobile. MEADS will defend population centers, vital assets, and forces by countering short- and medium-range ballistic missile threats in the terminal phase of their flight. MEADS will integrate the PAC-3 hit-to-kill interceptor into a system that can move with and protect forces as they maneuver in combat.

2.1.2 BMDS Functional Capabilities

The ability of the proposed BMDS to achieve a layered defense can be described in terms of ***functional capabilities***. The functional capabilities of the BMDS would be developed with the objective of deploying an initial set of capabilities by 2004-2005 and enhancing these capabilities over time.

Functional capabilities: The capability of the proposed BMDS to detect, identify, track, discriminate, intercept, and destroy a threat ballistic missile during a specific phase of flight (i.e., boost, midcourse, or terminal). Functional capabilities are the abilities to negate specific ballistic missile threats.

The functional capabilities of the proposed BMDS include the long-term flexibility of the BMDS to evolve to meet future threats. To engage a threat, an **engagement sequence** is needed.

> ***Engagement Sequence*:** A unique combination of detect-control-engage functions performed by BMDS components (e.g., sensors, weapons, and C2BMC equipment) used to engage a threat ballistic missile. The command and control, battle management, and fire control functions enable the engagement sequence.

Combinations of these capabilities with common characteristics, called **engagement sequence groups (ESGs)**, may be used to simplify the specification of BMDS capabilities and to more easily assess system performance during testing and operations.

> ***Engagement Sequence Group (ESG):*** The logical categorization of engagement sequences based upon common capabilities or characteristics (e.g., sensors, weapons, and C2BMC equipment) that perform overlapping or similar functions in the execution of an engagement. Using ESGs as a tool enhances functional and engineering analysis, creates manageable combinations for Initial Defensive Operations and Block configurations, simplifies allocation of BMDS capabilities, provides a structure to assess BMDS performance, and assists the warfighter in operating the BMDS.

The BMDS would need to

1. Provide input for missile defense battle management decisions

The BMDS should provide a way to decide when a foreign missile launch poses a threat that warrants a response, what response to take, and when the threat has been negated. The BMDS must be able to obtain the necessary information and provide it to the decision-maker in a timely manner. Functional capabilities needed to provide the information include the ability to

- Detect threat missile launches,
- Determine threat posed by missile (including type of warhead and potential payload),
- Track missile flight path,
- Predict threat impact location(s),
- Communicate with defensive weapons to direct the intercept, and
- Detect/assess the intercept.

2. Negate threat missiles during flight

The BMDS should have the capability to destroy threat missiles anywhere along the flight trajectory. Functional capabilities that the BMDS must have to destroy threat missiles include the ability to

- Launch a defensive weapon,
- Overcome any countermeasures released by a threat missile,
- Guide defensive weapon to critical point,
- Engage threat missile, and
- Negate threat payload.

3. Provide multiple engagement opportunities during flight

The BMDS should provide multiple engagement opportunities along a flight path. Threat missiles evading initial intercept attempts could be negated by subsequent attempts. This capability also provides opportunities to destroy the threat while it is over enemy territory (i.e., during boost) or over sparsely populated areas (i.e., during midcourse flight). Functional capabilities needed to provide multiple engagement opportunities include the ability to

- Coordinate and manage multiple weapon launches,
- Sustain/maintain launch facilities, and
- Engage threat missile in all flight phases.

4. Provide robust defense against evolving threats

The BMDS should have the capability to adjust to a constantly evolving threat environment. Enemies will adjust and develop their offensive tactics and capabilities. Changing political situations may shift where threat missiles may be launched and the theater of operations the BMDS must protect. Functional capabilities that must be developed to defend against evolving threats include

- Interoperable technologies that can work in various combinations, and
- Interoperable technologies that are deployable where needed.

According to the functional capabilities currently identified for the proposed BMDS, the system would detect, identify, track, discriminate, engage, and destroy ballistic missiles in all phases of flight that threaten the U.S. and its deployed forces, allies, and friends. To achieve these functional capabilities, the proposed BMDS would be a system of integrated technologies, or **components,** that are greater than the sum of the current defensive elements. The components of the BMDS are

- Weapons (i.e., interceptors and lasers),
- Sensors (i.e., radars, infrared, optical, and lasers),
- C2BMC, and
- Support Assets (i.e., auxiliary equipment, infrastructure, and test assets).

Individual components can be thought of as “tools” or “building blocks” that could be combined in different ways to meet the required functional capabilities of the proposed BMDS. Components would contribute to the functional capabilities as described in Exhibit 2-6.

Exhibit 2-6. Crosswalk of Functional Capability with Components

FUNCTIONAL CAPABILITY	COMPONENTS			
	Weapons	**Sensors**	**C2BMC**	**Support Assets**
1. Input for Missile Defense Battle Management Decision				
Detect Threat Missile Launches		X		X
Determine Threat Posed by Missile		X	X	X
Track Missile Flight Path		X		X
Predict Impact Location		X	X	X
Communicate with Other Elements and Weapon System	X	X	X	X
Detect/Assess Intercept		X	X	X
2. Negate Threat Missiles During Flight				
Launch Defensive Weapon	X		X	X
Overcome Countermeasures	X	X		X
Guide Weapon to Critical Point	X	X	X	X
Interrupt Missile Flight	X			X
Negate Threat Payload (Lethality)	X			X
3. Provide Multiple Engagement Opportunities During Flight				
Coordinate Multiple Weapon Launches	X	X	X	X

Exhibit 2-6. Crosswalk of Functional Capability with Components

FUNCTIONAL CAPABILITY	COMPONENTS			
	Weapons	Sensors	C2BMC	Support Assets
Engage Threat Missile in All Flight Phases	X	X	X	X
4. Provide Robust Defense Against Evolving Threats				
Interoperability of Components	X	X	X	X
Deployable Where Needed	X	X	X	X

The BMDS functional capabilities would evolve over time in response to newly defined threats and technology developments. As the functional capabilities change, individual components and elements would be enhanced with new technologies to meet those threats. The evolution of the proposed BMDS is described in Section 2.1.3 BMDS System Acquisition Process below.

2.1.3 BMDS System Acquisition Approach

2.1.3.1 Traditional Approach to Missile Defense Acquisition

The system acquisition process for evolving defensive systems historically required defined system architectures. Under the traditional approach, the MDA primarily focused on developing single elements and associated technologies that could provide independent defensive military utility. These stand-alone elements can be characterized as packages of components, typically comprised of sensors, a weapon, accompanying C2BMC hardware and software, and support assets.

The traditional acquisition process focused on developing, testing, and procuring individual elements with certain functional defensive capabilities. However, this process can also require a rigid adherence to a defined life cycle. All components of an element must meet all existing weapons acquisition specific test, development, and operational requirements before the element can be produced and procured. This inflexible process can be redundant and inefficient as technical challenges associated with one component might delay the progress of other components in an element. The initial focus of the DoD on developing and acquiring elements resulted in several NEPA analyses to support the development, testing, and procurement of the proposed defensive elements and their components. Detailed discussions of these elements can be found in Appendix D.

2.1.3.2 New Approach to Proposed BMDS

The MDA, as the acquisition agency for the BMDS, has implemented a new, more flexible approach to developing the proposed BMDS. This approach is capability-driven and component-based rather than focused on specific elements or programs. Capability-based planning allows MDA to develop capabilities and objectives based on technology feasibility, engineering analyses, and the capability of the threat. This development involves an iterative process known as spiral development that refines program objectives as technology becomes available through research and testing with continuous feedback between MDA, the test community, and the military operators. Thus MDA can consider deployment of a missile defense system that has no specified final architecture and no set operational requirements but which will be improved incrementally over time.

MDA's approach to accomplish the goal of developing an integrated, layered BMDS capable of engaging enemy ballistic missiles of all ranges during the boost, midcourse and terminal phases of flight would focus on

- Fielding an initial defensive capability (IDC) in accordance with the President's direction;
- Adding interceptors and networked, forward-deployed ground-, sea- and space-based sensors to make the interceptors more effective in 2006-2007; and
- Adding layers of increasingly capable weapons and sensors, made possible by inserting emerging technologies.

The approach for incremental improvement involves

- Determining functional capability needs,
- Identifying potential ways to meet these needs with new and/or enhanced components,
- Using a spiral development process to develop, test, and identify new technologies, and
- Fielding only those new and/or enhanced components with proven ability to meet the identified functional capability needs.

Spiral development begins when a desired functional capability is identified. The ability of existing components and emerging technologies to meet the functional capability would be reviewed and efforts to develop or enhance specific components would be initiated. Testing and ongoing modification would be used to determine the ability of each component to meet the functional capability needs. For example, new components would undergo initial development or proof-of-concept testing, while existing components would be tested to determine their readiness for use. Work on a given technology improvement would stop if testing failed to demonstrate effectiveness or functional capability needs changed.

The process is organized into two-year time windows, or **Blocks**, consisting of packages of capabilities that are being developed over several years. For example, Block 2004 represents years 2004-2005, and Block 2006 represents years 2006-2007. During each Block, the MDA would research, develop, and test components in varying stages of development.

> ***Block***: A block is a two-year increment of the BMDS providing an integrated set of capabilities, which has been rigorously tested as part of the BMDS Test Bed and assessed to adequately characterize its military utility. The configuration for each block is drawn from the prior BMDS Block; BMDS elements, components, technologies, and concepts; C2BMC architecture; and externally managed systems, elements or technologies.

Thus, the development and testing of individual components to meet a specific BMDS functional capability would "spiral" through several successive Blocks (see Exhibit 2-7). When appropriate, spiral development within block increments would help keep pace with useful technology improvements, reduce risk through iterative reviews, and match user expectations with delivered performance to provide improved capabilities as quickly as possible. Eventually, some components would be transitioned to the military service responsible for deployment, operation and maintenance. Evolutionary acquisition in block increments would provide a practical approach to aggressively develop and field early BMDS capabilities while preserving flexibility to respond to evolving ballistic missile threats and incorporate improved technology.

Exhibit 2-7. Block Development Process

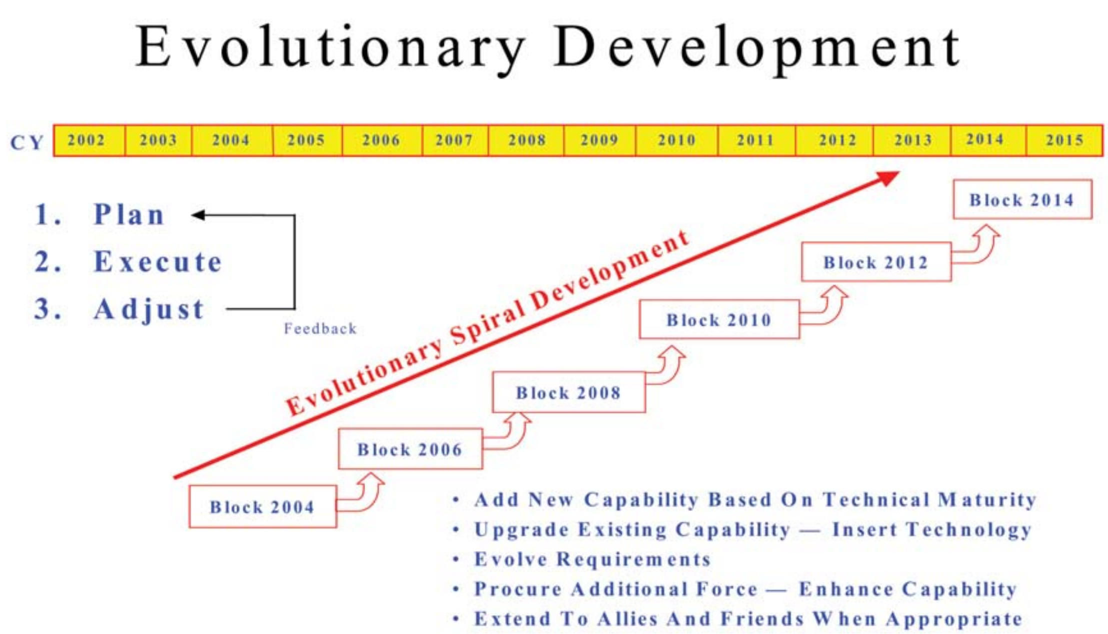
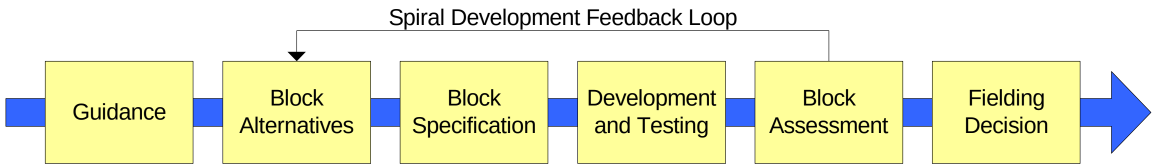


Exhibit 2-8 shows spiral development via the systems engineering process.

Exhibit 2-8. The MDA Systems Engineering Process



The engineering principle for organizing and discussing the BMDS capability is the ESG, which is a means to categorize or group similar engagement sequences based on capability or function. An engagement sequence is a unique combination of detect-control-engage functions performed by BMDS components used to engage a threat ballistic missile; it would define a specific detection sensor, specific fire control radar and specific weapon. ESGs define the sequence of events, functions, and system components used to enable a weapon to engage a target and provide the structure for measuring the level of performance and integration maturity of the BMDS. ESGs also relate multiple ways of engaging a target.

An example of an ESG is an intercept scenario in which the GBI would receive its final target update from the COBRA DANE Radar. As the BMDS grows in complexity, i.e., integration of many elements and components, the number of ESGs will increase, thereby increasing system capability. Better information about the threat from additional sensors and more chances to destroy the threat from additional weapons will also result in enhanced system performance. Using ESG as a tool enhances functional and engineering analysis creates manageable combinations for Block configurations, simplifies allocation of BMDS capabilities, provides a structure to assess BMDS performance, and assists the warfighter in operating the BMDS.

2.2 BMDS Components

The components of the proposed BMDS are weapons, sensors, C2BMC, and support assets that as part of the existing or envisioned elements can provide the functional capabilities of the BMDS. The proposed BMDS would integrate components in a unified system. The general characteristics of these components are described in the following sections. Descriptions of components of existing elements are provided in Appendix D.

2.2.1 Weapons

Weapons are the components of the BMDS that can be used to destroy threat missiles. For the BMDS, weapons consist of various types of interceptors and directed energy weapons (e.g., high energy lasers [HELs]). Interceptors would use two primary kinetic energy technologies, hit-to-kill or direct impact and directed fragmentation.

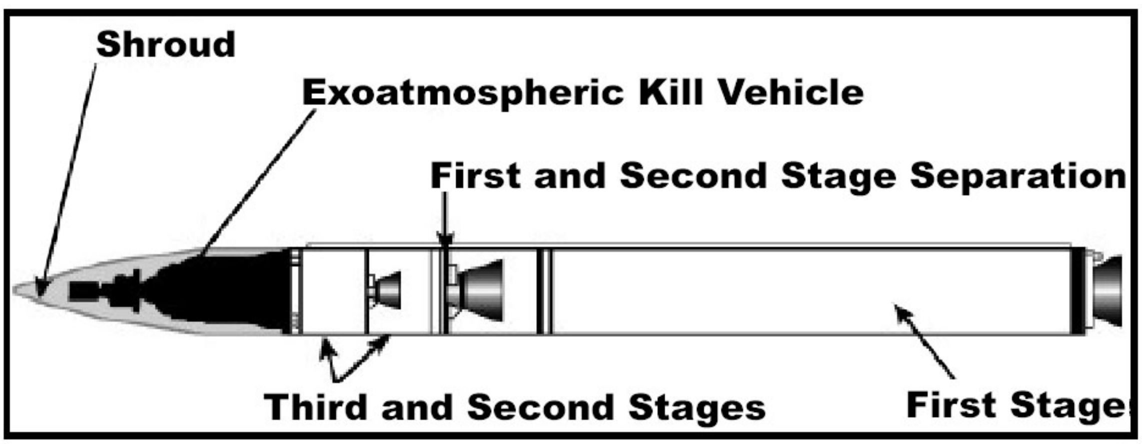
Interceptors must conduct multiple tasks simultaneously, adjust flight path accurately, discriminate the reentry vehicle from countermeasures, and engage and negate the threat missile. BMDS interceptors could be placed on land, sea-, air-, or space-based platforms. BMDS directed energy systems are currently envisioned to perform target illumination and tracking and to negate threat missiles from an air-based platform, although they could also be placed on land-, sea-, or space-based platforms.

2.2.1.1 Weapons Technologies and Subcomponents

Interceptors

Interceptors use kinetic energy either in a direct impact or hit-to-kill mode, or to deflect or possibly destroy a threat missile by directed blast fragmentation. Interceptors are composed of two primary parts, a booster and a kill vehicle (see Exhibit 2-9). An interceptor may have one or more boosters (also called stages). The number of boosters or stages refers to the number of rocket motors that sequentially activate. Multiple stages allow the interceptor to fly at higher velocities and altitudes, and for longer distances. The kill vehicle is the portion of the interceptor that performs the intercept and destroys the threat missile. It is anticipated that solid and liquid propellants would be used in the boosters and in the kill vehicles. For the purposes of this PEIS, interceptors will be discussed and analyzed for environmental impacts at the booster and kill vehicle level. This will allow the MDA the flexibility to configure new interceptors based on boosters and kill vehicles analyzed in this document to address new or emerging threats.

Exhibit 2-9. Interceptor Schematic



Interceptors may also use lethality enhancers, seekers, and attitude control systems. Lethality enhancers are non-nuclear explosive devices that increase the probability of destroying the threat missile and its payload (e.g., explosives, chemical or biological agents). Seekers help to detect the threat missile and home in on it. Attitude controls are small motors used to modify the flight path of the kill vehicle and position it into the

flight path of the threat missile. All of these are important parts of interceptors and the environmental impacts from their use will be considered as part of the analysis of boosters and kill vehicles in this PEIS.

Boosters use two broad classes of propellants: solid and liquid. Propellants consist of a fuel and oxidizer. An oxidizer is a substance such as perchlorate, permanganate, peroxide, and nitrate that yields oxygen readily to support the combustion of organic matter, powdered metals and other flammable material. Boosters can use liquid hydrocarbon propellants (e.g., kerosene) plus an oxidizer such as liquid oxygen; cryogenic propellants (e.g., liquid oxygen or liquid hydrogen [H_2]) where the fuel and oxidizer are maintained at very low temperatures; hypergolic propellants (e.g., hydrazine [fuel] and nitrogen tetroxide [oxidizer]) where mixing the fuel and oxidizer ignites the engine without requiring an external ignition source; or solid propellant (e.g., polybutadiene matrix, acrylonitrile oxidizer and powdered aluminum). Solid rocket motors can also be used as external motors to supplement the thrust of the first stage of an interceptor. Some propellants such as hydrogen peroxide can be used in concentrated form as a monopropellant or in conjunction with other propellants.

Interceptor Technology

As mentioned above there are two major kinetic energy technologies employed by interceptors, hit-to-kill and directed blast fragmentation.

Hit-To-Kill

Hit-to-kill technology relies on high closing speeds of an interceptor to collide with and destroy the threat missile. The interceptor uses kinetic energy, that is, the force of the collision, to destroy the threat warhead. Most of the BMDS elements, e.g., GMD, Aegis BMD, THAAD, and PAC-3, use this interceptor technology. Exhibit 2-10 shows an example of an interceptor launch.

Exhibit 2-10. Interceptor Launch

Directed Blast Fragmentation

Directed blast fragmentation technology involves the interceptor approaching the threat ballistic missile and exploding close to it, thereby disrupting the path of the threat missile and possibly destroying it. The interceptor does not actually collide with the threat ballistic missile. A directed blast fragmentation kill vehicle explodes near the threat missile and distributes its fragments over a large area to create a kill zone around the path of

the threat missile. As the quickly moving threat missile enters the kill zone it collides with the fragments, which alter its path and potentially destroy the threat missile altogether. Arrow and PATRIOT systems currently include this technology.

Lasers

Laser use directed energy to destroy threat ballistic missiles. High mobility and speed-of-light intercept are key aspects of directed energy weapons. The ABL element currently uses this laser technology.

A megawatt class chemical HEL is being developed as part of the BMDS boost phase defense system. HEL devices are laser systems that use high speed flowing gas or large amounts of electrical power, or combinations of the two, to produce directed beams of energy. The chemical oxygen iodine laser (COIL) is one of three lasers under consideration to be integrated into the BMDS. The COIL operates by creating chemical reactions between chlorine gas and a mixture of hydrogen peroxide and alkali metal hydroxides. The chemical reactions produce a form of oxygen (singlet delta) that is used to transfer the energy to atoms of iodine. The iodine, in turn, releases this energy as light, which is then focused by mirrors and lenses into a laser beam. The COIL has four primary parts: oxygen generator, gain generator (or resonator), pressure recovery system, and storage tanks that hold all the chemicals needed to operate the laser. Directed energy from the laser weapon would heat the threat missile body canister causing overpressure and/or stress fracture, which would destroy the missile. The HEL could be mounted on an aircraft and flown at high altitudes to detect, track, and destroy threat missiles in the boost phase.

2.2.1.2 Weapons Basing Platforms

There are four primary weapons basing platforms considered in this PEIS: land, air, sea, and space. Some of the interceptor and laser technologies could be based on more than one type of platform while others might be based on only a single platform. The basing platform for a weapon would affect the impact that the weapon has on the environment. The weapons basing platform may also affect the phase of flight in which the weapon can intercept a threat missile. The description and analysis of the support equipment and infrastructure associated with the fixed weapons basing platforms (e.g., missile silos, launch pads, sled tracks) and the mobile weapons basing platforms (e.g., mobile launchers, aircraft, ships, satellites) are presented under Support Assets, equipment and infrastructure, respectively.

Land-based Platforms

Land platforms would be either fixed or mobile. The fixed land platforms would include missile silos, launch pads, and launch stools from which interceptor missiles could be launched. Sled tracks and engine test stands could be used to test motors for interceptors or conduct GTs of directed energy weapons. Mobile land platforms currently include mobile launchers mounted on trucks or trains and moved into the desired location. The following BMDS weapons would use land platforms: KEI, GBI, THAAD, PAC-3, AWS and MEADS.

Air-based Platforms

Air platforms would include balloons and aircraft of various types and sizes. The ABL is currently the only proposed BMDS element with a weapon using an air platform, i.e., the HEL.

Sea-based Platforms

Sea platforms would be either fixed or mobile. The fixed platforms would include man-made islands or vessels anchored to the sea floor. The mobile platforms would be either self-propelled or moved or towed via a tug vessel. These could include ships, submarines, and other sea-faring vessels (e.g., platforms not anchored to the sea floor). The KEI and the Standard Missile (SM) are currently the proposed BMDS weapons using a sea platform.

Space-based Platforms

Space platforms would carry sensors and/or weapons and would be carried into space by launch vehicles. Once released by the launch vehicle, the space platform would maneuver into the appropriate orbit around the Earth using on-board propulsion systems. The platforms could be maneuvered into several different types of orbits including Geosynchronous Earth Orbit (GEO), which allows the platform to remain positioned over one location on the Earth, and Low Earth Orbit (LEO), which allows the platform to be positioned over various parts of the Earth at different times. The space platforms would maintain their orbit by using on-board propulsion systems for the duration of their useful life. The proposed KEI and space-based lasers are types of weapons that could use a space platform.

2.2.2 Sensors

Sensors are the tools that function as the “eyes and ears” of the BMDS. BMDS sensors would provide the relevant incoming data for threat ballistic missiles. Detailed sensor descriptions can be found in Appendix E. The data from these sensors would travel

through the communication systems of the proposed BMDS to Command and Control (C2) where a decision would be made to employ a defensive weapon such as launching an interceptor. The BMDS sensors would provide the information needed to determine the origin and path of a threat missile to support coordinated and effective decision-making against the threat. Additionally, these sensors would provide data on the effectiveness of the defense employed, that is, whether the threat has been negated.

BMDS sensors would be developed or enhanced to acquire, record, and process data on threat missiles and interceptor missiles; detect and track threat missiles; direct interceptor missiles or other defenses (e.g., lasers); and assess whether a threat missile has been destroyed. These sensors (i.e., radar, infrared, optical, and laser) would include signal-processing subcomponents, which receive raw data and use hardware and software to process these data to determine the threat missile’s location, direction, velocity, and altitude. This and other relevant information would then be integrated into planning and controlling intercept engagements through the C2BMC component of the BMDS. For the purposes of this PEIS, the analysis of sensor systems will focus on the emissions power and range of the sensor categories to determine which sensors have the most potential for environmental impacts.

The three general categories of sensors considered in this PEIS include

- **Weapon/Element Sensors**. These sensors are part of the individual weapons and elements and allow them to operate independently from the overall BMDS. An example of this type of sensor is the PATRIOT radar. Although weapon/element sensors are designed for independent utility, they would also have the capability to function as an integrated part of the BMDS both in a testing or deployment scenario. For example, the ABL sensors could serve as forward sensors for the BMDS and could be used during testing to provide target information to midcourse and terminal phase weapon components. Discussion of sensors in this category is found under the individual Weapon/Element discussions in Appendices D and E of this PEIS.

- **BMDS Mission Sensors.** These are radar and optical sensors that are not part of an element but would provide data essential to the functional capabilities of the BMDS. These independent sensors would provide information for missile warning, early interceptor commit, in-flight target updates, and target object maps through the BMDS C2BMC architecture to the BMDS and its components. The MDA would include these existing sensors in testing activities either as part of the BMDS architecture or to evaluate a test of other parts of the BMDS architecture. For example, an EWR, such as the Position and Velocity Extraction Phased Array Warning System (PAVE PAWS), could be used to identify an ICBM target and provide cueing information to a midcourse sensor, such as SBX, to test sensor interoperability.

- **Test Range Telemetry Sensors.** These are the sensor systems used to acquire, record, and process data on targets and interceptor missiles during testing on a test range. They detect and track targets, observe defensive weapons, and assess whether a target has been destroyed. They also support range safety activities by providing test operators with information on whether the range is clear of non-test participants (i.e., recreational boats, private aircraft, etc.) and the test is proceeding within planned parameters. These sensors are not part of the actual BMDS, but are considered part of the BMDS Test Bed. Test range telemetry sensors include fixed sensors at test range facilities and mobile sensors at test range facilities or on ships or aircraft. Mobile sensor capabilities add flexibility for testing while minimizing fixed infrastructure investment. The description and analysis of such sensors are presented under Support Assets - Test Assets.

Sensors can also be described in terms of the technologies employed in the various sensor types as discussed below.

2.2.2.1 Sensor Technologies

The technologies used by the existing and proposed BMDS sensors fit into four basic categories, ***radar***, ***infrared***, ***optical***, and ***laser***, based on the frequency or electromagnetic (EM) energy spectrum used by the sensor.

Radar Technology

Radar, which stands for **RA**dio **D**etection **A**nd **R**anging, typically is an active sensor that emits radio frequency energy toward an object and measures the energy of radio waves reflected from the object. Radars are currently based in land and sea operating environments. Most modern radars operate in a frequency range of about 300 megahertz (MHz) to 30 gigahertz (GHz), which corresponds to a wavelength range of one meter to one centimeter. The time delay in the return signal or echo allows the determination of distance to the object and the change in the frequency of the echo through the Doppler Effect allows the determination of the object's speed. The Doppler Effect is the shift in frequency resulting from relative motion of an object in relation to, in this case, the radar. Most current radars are mono-static because the transmitter and receiver are collocated. There are also radars with multiple transmitters and multiple receivers in different locations that are called bi-static and multi-static radars based on the number of transmitters and receivers. Exhibit 2-11 summarizes the wavelengths and frequencies of radar bands.

Exhibit 2-11. Radar Band Designations

Band	Wavelength Ranges	Frequency Ranges
High Frequency	100-10 meters (328-33 feet)	3-30 MHz
Very High Frequency	10-1 meters (33-3.3 feet)	30-300 MHz
Ultra High Frequency	1 meter-10 centimeters (3.3 feet-4 inches)	300-3,000 MHz
L band	30-15 centimeters (12-6 inches)	1-2 GHz
C band	15-7.5 centimeters (6-3 inches)	2-4 GHz
S band	7.5-3.75 centimeters (3-1.5 inches)	4-8 GHz
X band	3.75-2.50 centimeters (1.5-1 inches)	8-12 GHz
Ku band	2.5-1.67 centimeters (1-0.66 inches)	12-18 GHz
K band	1.67-1.11 centimeters (0.66-0.44 inches)	18-27 GHz
Ka band	1.11-0.75 centimeters (0.44-0.30 inches)	27-40 GHz
W band	3 millimeters (0.12 inches)	95 GHz
Mm band	-	110-300 GHz

Infrared Technology

Infrared sensors detect the heat energy or infrared radiation from an object. Infrared electromagnetic radiation (EMR) has wavelengths longer than the red end of visible light and shorter than microwaves (roughly between one and 100 microns). The Defense Support Program (DSP) satellite, as shown in Exhibit 2-12, is an example of a space-based infrared sensor (SBIRS) that can detect the heat signature or plume from the launch of a ballistic missile.

Exhibit 2-12. DSP Satellite

Optical Technology

Optical sensors operate in the **visible** range and are generally passive sensors that detect objects or missiles by collecting light energy or radiation emitted from the target in wavelengths visible to the human eye. Specifically, the human eye perceives this radiation as colors ranging from red (longer wavelengths, approximately 700 nanometers) to violet (shorter wavelengths, approximately 400 nanometers). The planned Space Tracking and Surveillance System (STSS) satellites, for example, would have both infrared and optical sensors.

Laser Technology

Laser is an acronym for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation. Laser sensors use laser energy of various energy levels and frequencies (ultraviolet, visible) to illuminate an object to detect the object's motion. Like radar, a laser-based sensor is an active sensor that sends out laser energy toward an object and then receives a return echo from the object. The time delay in the return signal or echo allows the determination of distance to the object and the change in the frequency of the echo through the Doppler Effect allows the determination of the object's speed. The ABL aircraft uses passive infrared sensors to detect, and laser sensors to illuminate and track threat ballistic missiles.

2.2.2.2 Sensor Operating Environments

The operating environments of the existing and proposed BMDS sensors can be considered in four general categories. **Land-based** sensors may be fixed, located in or on a building, or mobile, located on a vehicle or trailer. **Air-based** sensors are located on platforms that can travel through the air such as airplanes, balloons, and airships. **Sea-based** sensors are located on platforms that travel on water (e.g., ships or a floating platform) or are fixed in water (e.g., a man-made island or platform like an oil platform that is fixed to the seafloor). **Space-based** sensors are located on satellites, which travel in circular or elliptical orbits around the Earth. These satellites can be in several different types of orbits including GEO, which is an orbit at approximately 36,000 kilometers (21,700 miles), synchronized with the Earth's rotation, and LEO, which is an orbit at an altitude of approximately 160 to 1,600 kilometers (100 to 1,000 miles). Weather, communications, and some military satellites, such as DSP satellites, typically use GEO orbits.

The following exhibit outlines many of the current and proposed sensors that would or could be developed to provide the BMDS with the required sensor functionality. Exhibit 2-13 includes the proposed operating environment or current proposed location for each of the sensor types.

Exhibit 2-13. Proposed Sensors, Roles and Operating Environments

Sensor	Primary Function	Operating Environment
ABL Infrared Search and Track (IRST)	Infrared Sensor	Airborne
ABL-Active Ranging System (ARS)	Laser Sensor	Airborne
ABL-Beacon Illuminator Laser (BILL)	Laser Sensor	Airborne
ABL-Track Illuminator Laser (TILL)	Laser Sensor	Airborne
Advanced Research Project Agency Lincoln C-band Observable Radar (ALCOR)	Tracking Radar	Fixed land-based
Aegis SPY-1 Radar	Fire Control Radar	Mobile sea-based
Arrow Fire Control Radar	Warning and Fire Control Radar	Mobile land-based
Forward-Based X-Band Radar Transportable (FBX-T)	Tracking and Discrimination Radar	Mobile land-based
Ballistic Missile Early Warning System (BMEWS)	EWR	Fixed land-based
COBRA DANE	EWR	Fixed land-based
U.S. Naval Ship Observation Island	Radar	Mobile sea-based observation platform
DSP	Infrared Sensor	Space-based
Ground Based Radar Prototype (GBR-P)	Fire Control Radar	Fixed land-based
Innovative Science and Technology Experimentation Facility (ISTEF)	Optical and laser sensors	Land-based sensor experimentation facility
ISTEF Mobile Sensors	Optical and laser sensors	Mobile sensor systems based at ISTEF
Maui Space Surveillance System (MSSS) [a.k.a. AMOS]	Optical Infrared Sensor	Fixed land-based
MEADS Surveillance Radar	Warning and Fire Control Radar	Mobile land-based

Exhibit 2-13. Proposed Sensors, Roles and Operating Environments

Sensor	Primary Function	Operating Environment
PATRIOT Radar	Warning and Fire Control Radar	Mobile land-based
PAVE PAWS Radar	Early Warning Radar	Fixed land-based
SBX	Tracking and Discrimination Radar	Mobile, sea-based platform
STSS	Infrared Sensor	Space-based
SBIRS-High	Infrared Sensor	Space-based
THAAD Radar	Warning and Fire Control Radar	Mobile land-based
Transportable System Radar (TPS-X)	Instrumentation Test Bed Radar	Mobile land-based

2.2.3 Command and Control, Battle Management, and Communications (C2BMC)

C2BMC would provide the rules, tools, displays and connectivity to enable the proposed BMDS to engage threat missiles. C2BMC would be the overall integrator of the BMDS. C2BMC would consist of electronic equipment and software that enable military commanders to receive and process information, make decisions, and communicate those decisions regarding the engagement of threat missiles (see Exhibit 2-14). This would include computer workstations installed in existing infrastructure at certain locations, and may include new fiber optic cable, radios, and satellite communications.

Exhibit 2-14. Typical Command Center

C2BMC would be designed and built to provide war fighters with the capability to effectively plan and execute the MDA's mission. C2BMC would integrate and expand existing capabilities that provide the flexibility to exploit a wide range of tactics, techniques and procedures and BM options. The goal of C2BMC is to achieve seamlessness in a layered defense through coordinated C2 and integrated fire control.

Specifically, C2BMC would receive, process, and display tracking and status data from multiple elements, components and sensors so that local commanders at various locations would have the same integrated operating picture and could make coordinated decisions about deploying weapons. This would allow the central command structure to use the most effective weapons to engage threat ballistic missiles in all flight phases.

The BMDS C2BMC includes three primary parts, Command and Control (C2), Battle Management (BM), and Communications that would operate in an integrated fashion across all BMDS components.

- **C2** would provide a flexible, integrated architecture to plan, direct, control and monitor BMDS activities. C2 would provide decision-aid applications that integrate information and recommendations for defensive options in near real-time to develop the operational war fighting aids required for formulating and implementing informed decisions and reduce decision cycles. This would permit quick redirection and reallocation of assets based on rapidly changing situations and threats. C2 also would integrate the Unified Commands, North Atlantic Treaty Organization and other allies, friends, and other external systems to which C2 would connect.

- **BM** would control the launching or firing of missiles and integrate the kill chain functions (surveillance, detect/track/classify, engage and assess) across the layered defenses (boost, midcourse and terminal). Initially, BM would provide the means for executing preplanned responses by integrating available information to provide near real-time tasking and status. As the BMDS evolves, BM would evolve to provide the user with increased automation, capability, and ability to integrate information from increasingly diverse resources. Advancements in BM are intended to further increase the battle space with continued improvements in tracking and discrimination information, sensor netting, operability with coalition partners, near real time intelligence, battlefield learning and dynamic planning, and integrated BM execution using disparate sensors and firing units.

- **Communications** would allow all BMDS components to exchange data and network with BMDS assets. The goal of BMDS communications is to provide robust networks that manage the dissemination of the information necessary to perform the C2 and BM objectives. The communications networks would seamlessly connect BMDS components and link them with other applicable DoD and non-DoD networks and assets as required. The network infrastructure would make optimal use of existing data and information conduits and protocols.

The long-term development of the C2BMC would begin with planning and monitoring the autonomous operation of elements with stand-alone capability and expand to the centralized and integrated control of the BMDS. Currently, each BMDS element, such as THAAD, PAC-3, or ABL operates or is designed to operate as an autonomous unit, each

with stand-alone capability and with its own BM, C2 and communications system (i.e., element-specific BMC3). C2BMC would fuse the data of these BMC3 components by integrating communications to provide a more robust picture of the operational arena. Individual element weapon system component descriptions can be found in Appendix D.

For example, a BMDS element like the PAC-3 has an internal or organic BMC3 component that transfers needed data from its data-gathering sensors (e.g., satellites and radars) to its local military commander. Using the information, the local military commander can make a BM decision to launch a weapon at the incoming threat ballistic missile. The BMDS C2BMC would capture and display tracking and status data from multiple existing and proposed weapon systems' BMC3 systems and sensors so that local commanders at various locations would have the same integrated operating picture and could make coordinated decisions about deploying weapons. C2BMC would include existing and new land-, sea-, air- and space-based C2BMC systems.

In an integrated BMDS, C2BMC would ensure interoperability with other BMDS components in reacting to the threat. For example, if an ABL sensor identifies the presence of an incoming ballistic missile, the information would be transmitted to the BMDS C2BMC. In coordination with other incoming information across the BMDS, a decision could be made that an Aegis cruiser launching a Standard Missile-3 (SM-3) would be the most effective element to engage and negate the threat missile. The commander of the cruiser would have real-time knowledge of the decision to quickly launch an SM-3 interceptor against the threat missile.

The MDA plans to improve the internal BMC3 capabilities of each BMDS element and to develop and continually upgrade the overall BMDS C2BMC. New or additional sensors and communications nodes would be incorporated, as well as new target discrimination algorithms, as they are developed.

Various U.S. command centers would eventually house a C2BMC node. A node is a set of equipment and processes that performs the communications functions at the end of the data links that interconnect those elements, which are resident on the networks. C2BMC nodes are located at geographically dispersed facilities and receive and display tracking and status data from multiple BMDS components so that local commanders can make coordinated decisions about deploying weapons. Each node consists of electronic equipment, software, computer workstations, radios, fiber optic cables, and communication devices. Nodes at various locations integrate and communicate data using this hardware and software to support C2 and BM activities. Each of these nodes would receive and display the same data to local commanders so that they can make coordinated decisions about weapons use.

2.2.4 Support Assets

Support assets are comprised of auxiliary equipment, infrastructure, and test assets that facilitate BMDS operations. Some of the support equipment (e.g., tracking stations and data processing systems) and infrastructure (e.g., test ranges and launch facilities), and all test assets comprise the BMDS Test Bed. They enable BMDS components to operate at maximum effectiveness over an extended useful life. Assets that support BMDS components include mobile equipment, such as cooling systems, power generators, and operator control units as well as fixed infrastructure such as docks and shipyards, launch facilities, airports and air stations, and communication facilities. Support assets as described above will be analyzed separately from their associated component.

Test assets used for component and system testing and deployment purposes include mobile equipment, infrastructure, and other equipment (e.g., target missiles). Although these test assets are not components of the BMDS, they are critical to its effective development and demonstration. Typical test assets would include test range facilities, targets, countermeasure devices, test sensors, optical and infrared cameras, computers, and observation vehicles (e.g., aircraft, ship, trucks, etc.). These test assets are designed to simulate a threat missile in a realistic environment and to assess and enhance the performance of BMDS components in negating those threats.

2.2.4.1 Equipment

The MDA would use a variety of equipment to support the functioning of BMDS components. Interceptors may require generators, fuel tanks, lightning protection, and security surveillance systems. Some weapons elements have mobile launchers such as the THAAD’s modified M-1120 Heavy Expanded Mobility Tactical Truck-Load Handling System Palletized Load System launcher, as presented in Section 2.2.1.2, Weapons Basing Platforms. Support equipment for the ABL includes chemical transfer and recovery receptacles to capture laser chemicals from the aircraft and cooling systems for the laser. Existing aerospace ground equipment at each air base would be utilized where possible to support the ABL aircraft, as needed (e.g., generator to run the aircraft's electrical system). Sensors require antenna equipment units, electronic equipment units, cooling equipment units, and prime power units. These units are housed on separate trailers interconnected with power and signal cabling, as required.

Mobile assets also may include trucks, telemetry vans, personnel trailers, rail cars, aircraft, ships, ocean tugs or barges. For each testing event or deployment location, the MDA would use these vehicles to transport the component, test assets (i.e., targets, sensors, telemetry, etc.), and personnel to the site.

2.2.4.2 Infrastructure

Infrastructure that supports the functions of BMDS components includes docks, shipyards, rocket and missile launch facilities, airports/air stations, and communication facilities. These facilities serve as a base of operation from which components begin their missions and return for maintenance, repair, or storage. The MDA would use existing facilities to the extent possible to minimize the need for new construction. Specific types of facilities that would support the BMDS are discussed below.

Docks and Navy Bases

Sea-based components (e.g., Aegis BMD configured ships, mobile launch platforms, transportable telemetry stations) would operate from existing U.S. Navy bases near deployment locations, and possibly other Federal, state and local assets if required. Sea-based platforms for sensors (e.g., SBX platform, mobile launch platform) would be launched from a base and transported to deployed locations at sea. Periodically, the platform would return to primary support base for repairs, maintenance, or upgrades. The operation of the SBX platform has been considered in the GMD ETR EIS.

Launch Facilities and Ranges

The MDA would use existing launch facilities like those at Cape Canaveral Air Station, the National Aeronautics and Space Administration's (NASA's) Kennedy Space Center and Wallops Flight Facility, Vandenberg AFB and the Kodiak Launch Complex (KLC) to launch test and defensive operational assets into orbit. As appropriate, test launch activities could also take place from these facilities. The MDA activities at these launch facilities would be the same as those for other non-BMDS launches at a DoD or NASA launch facility. Other test ranges, e.g., White Sands Missile Range (WSMR), Pacific Missile Range Facility (PMRF), Ronald Reagan Ballistic Missile Defense Test Site (RTS), etc., would continue to be used for various test events involving interceptor and/or target launches. These ranges and facilities comprise the BMDS Test Bed.

Airports and Air Stations

The MDA would use existing military airports and air stations as a base for operation of airborne components including airborne sensors and weapons. The suite of MDA airborne sensors would be installed and operated in modified civilian and military aircraft, which have the capability to land and takeoff from any large airport. The aircraft would use both contractor and military facilities. Hangars and maintenance facilities at the home air base would be used to maintain the airborne sensors.

Communication Facilities

The MDA would use the existing communication facilities (e.g., C2BMC nodes, transmission towers, and repeaters) located at existing military service installations, launch facilities, ranges, air stations, and on other federally owned or leased property. BMDS development, testing, and integration might require the modification of existing communication facilities, or the construction of new communication facilities within or outside such areas.

2.2.4.3 Test Assets

Test assets are not components of the BMDS but are support assets critical to its effective development and testing. Typical test assets would include test range facilities that make up the BMDS Test Bed, sensors used only for test purposes, targets, countermeasure devices, and warhead simulants. Test assets are designed to enhance the BMDS by simulating a threat missile in a realistic environment and to assess the performance of BMDS components in negating those simulated threats. The development and use of countermeasures and simulants in the BMDS test program are part of MDA's Measurement Program as identified in Section 2.2.5. In analyzing impacts of implementing the BMDS in Section 4, countermeasures and simulants will be considered as part of the test portion of the acquisition life cycle as part of Support Assets – Test Assets.

Test Bed

The BMDS Test Bed encompasses the infrastructure and environment where testing takes place. It provides a collection of integrated development hardware, software, prototypes, and surrogates, as well as supporting test infrastructure (e.g., instrumentation, safety/telemetry systems, and launch facilities) configured to support realistic development and testing of the BMDS. Exhibit 2-15 depicts key components of the BMDS Test Bed. The infrastructure primarily provides GT facilities, range and range instrumentation, and mobile sensors. The existing BMDS Test Bed infrastructure components that support testing as a secondary purpose (e.g., COBRA DANE and the EWR National Energy Technology Laboratory) are described under their respective component (e.g., sensors). A major focus is to develop infrastructure that enables realistic testing by permitting realistic geometries for sensor viewing and interceptor engagements. The Test Bed includes test locations already being used, such as GT sites, or already developed, such as the GMD ETR in the Pacific Ocean. In addition, testing could occur from existing operationally deployed sites in compliance with all applicable Federal, state, and local regulations. The MDA may also develop test beds in other areas such as the Atlantic Ocean, Gulf of Mexico, or outside the continental U.S. to support testing of BMDS components in those areas. In 2012, MDA contemplates the development of a space-based test bed; however, the concept is too speculative to be

analyzed in this PEIS. The BMDS Test Bed provides opportunities to use several target and interceptor missile trajectories that encompass a range of missile threats. Test Bed activities help wargames prove out doctrine; operational concepts; tactics, techniques, and procedures; and concept of operations (CONOPS) in militarily relevant environments.

Exhibit 2-15. BMDS Limited Defensive Capability Block 2004 Test Bed

BMDS Test Bed Components Providing *Limited Defensive Capability are Shown in Red Italicized Font.*

MDA's limited defensive capability (LDC) includes the BMDS components having a limited, combat capability to defeat adversary threats. The LDC allows Combatant Commanders use of the BMDS, to refine operational tactics, techniques, and procedures and exercise command control functions while maintaining a missile defense test and development program. For more discussion of BMDS fielding and deployment see Sections 2.3.3 and 2.3.1, respectively.

Test Sensors

The technology and operating environments for test range telemetry sensors, radars, and light detection and ranging (lidar) sensors are the same as the technology and operating environments of the element sensors and the BMDS mission sensors described in Section 2.2.2. During test planning, the MDA would identify the appropriate sensor that would provide the necessary location and functions to support achievement of the test

objectives. BMDS mission sensors and test range telemetry sensors as well as radars and lidars would be returned to their normal non-BMDS mission after each test event. Test sensors would be analyzed for environmental impacts in the same manner as described for weapons and mission sensors. Exhibit 2-16 provides information on representative test sensors that are available for use in BMDS testing. These sensors are further described in Appendix E.

Exhibit 2-16. Summary of Representative Test Sensors

Sensors	Type	Test Telemetry	Operating Environment
Advanced Missile Signature Center	Optical sensors	X	Fixed land-based facility
Air Force Research Laboratory (AFRL) Mobile Atmospheric Pollutant Mapper Carbon Dioxide (CO_2) Lidar	Test Lidar		Mobile land-based
AFRL Ka-Band Radar	Test Radar		Mobile land-based
AFRL Mobile Lidar Trailer	Test Lidar		Mobile land-based
ALTAIR	Test Radar	X	Fixed land-based
AN/FPQ-10 Upgraded	Test Radar	X	Fixed land-based
AN/FPS-16	Test Radar	X	Fixed land-based
AN/MPS-25 AN/MPS-25 (upgraded)	Test Radar	X	Fixed land-based
AN/MPS-36	Test Radar	X	Mobile land-based
AN/MPS-39	Test Radar	X	Mobile land-based
AN-TPQ-18	Test Radar	X	Fixed land-based
ATR-500C	Tracking Radar	X	Fixed land-based
FPQ-14	Test Radar	X	Fixed land-based
High Accuracy Instrumentation Radar (HAIR)	Range Radar	X	Fixed land-based
High Altitude Observatory (HALO)	Infrared/ Optical Sensor	X	Mobile air-based platform
Homing All-the-Way-Killer X-Band Doppler Radar	Test Radar		Fixed land-based
Midcourse Space Experiment (MSX)	Observatory sensors	X	Space-based
Millimeter Wave Radar	Test Radar	X	Fixed land-based
MK-74	Test Radar	X	Mobile land-based

Exhibit 2-16. Summary of Representative Test Sensors

Sensors	Type	Test Telemetry	Operating Environment
Recording Automatic Digital Optical Tracker	Optical sensor	X	Fixed land-based
Tracking and Discrimination Experiment Radar	Test Radar	X	Fixed land-based
W-Band Tornado Radar	Test Radar		Mobile land-based
Widebody Airborne Sensor Platform (WASP)	Tracking Radar	X	Mobile air-based platform

Targets

Because targets are test assets, they would not be deployed in the BMDS in the same way as weapons or sensors. Target missiles would be used to provide realistic threat challenges for testing new and evolving interceptor missile and sensor components that would comprise the BMDS. Target missiles would be used to validate the capabilities of the BMDS missile defense sensors and weapons. Target missiles typically mimic a possible threat, both in physical size and performance characteristics. A wide variety of target missiles would be used to support the development and test requirements of various BMDS elements, and validate their design and operational effectiveness. Targets would be used to test how well the BMDS can track the threat missile, communicate the threat to the appropriate ground command, and employ an interceptor to engage the threat. Targets can be launched from air, ground and sea platforms. The availability of multiple platform options allows the MDA to develop challenging and creative test scenarios, including salvos (i.e., simultaneous discharge of weapons), and also provides numerous viable options for test events to ensure safe testing.

Exhibit 2-17 shows the relative sizes and ranges of some typical test targets. Test targets are sometimes referred to by the names of their stages or motors.

Exhibit 2-17. Typical Test Targets

A typical target missile consists of one or more boosters and a target test object. Boosters are the rocket motors that sequentially activate to launch the missile. Target test objects are the parts of target missiles that are designed to represent threat warheads or reentry vehicles. (The term reentry vehicle is used in conjunction with threat missile.) A target test object typically separates from its booster(s); but some targets are non-separating.

Separating targets can be single-stage, meaning that they have one motor that initiates flight, or multiple-stage, with two or more motors that fire sequentially. Multiple stages allow a target missile to fly at higher velocities and altitudes, and for longer distances. Once the motor on a single-stage target has used all of its propellant, the spent stage may be jettisoned or released from the test object and falls back to Earth, often breaking up into small pieces before it reaches the surface of the designated test area. For targets with multiple stages, the first stage operates similar to a single stage target. However, after the first stage uses all of its propellant, that stage is jettisoned and the second stage or motor is ignited and the target continues on its path. This sequence of events is repeated until all of the stages have been used. Exhibit 2-18 lists the representative targets and boosters used by the MDA. There also are additional targets under development based on the Navy Trident-1 motors and alternative liquid fuel concepts.

Exhibit 2-18. Representative MDA Targets and Boosters

Targets	Aries
	Foreign Material Acquisition
	Hera
	Lance
	Liquid Propellant Target
	Long Range Air Launch Target
	Medium Range Target
	Minuteman II
	PATRIOT as a Target
	Peacekeeper Target Missile
	Short Range Air Launch Target
	Storm
	Strategic Target System
	Strypi
	Trident Target Missile, C-4
	Vandal
Boosters	Antares
	Black Brant
	Castor IVB
	Lynx
	Malemute
	M55, M56, M57
	Orbus
	SR-19
	Talos
	Terrier
	Trident C4 First Stage, Second Stage, Third Stage

The target test object would separate from the booster at a designated point in its flight. Test objects typically consist of steel or aluminum housing assembly, thermal sensors, guidance and control electronics, radio transmitters and receivers, a power supply (which may include lithium or nickel-cadmium batteries), and a Flight Termination System (FTS).

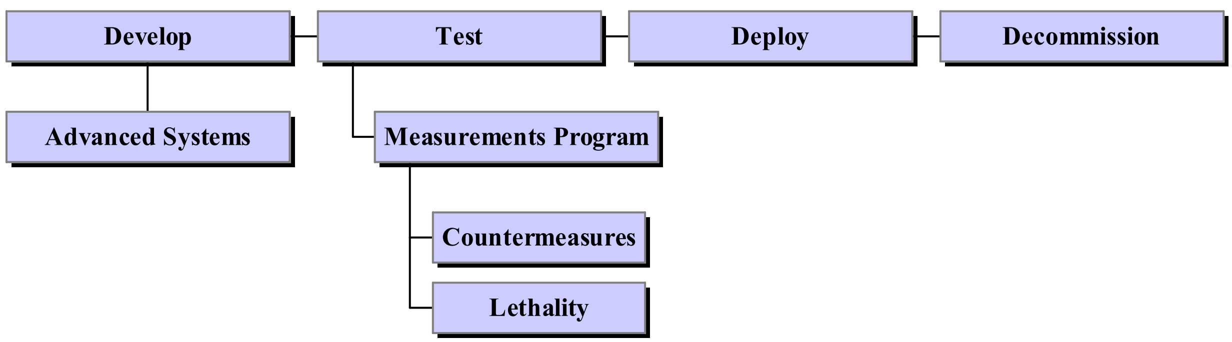
Target test objects may use countermeasures or decoys to imitate threat missiles as well as simulants to imitate the characteristics of the payload of a threat missile. Countermeasures are devices that accompany the target missile during its flight and attempt to confuse the sensors and C2 systems, making a successful intercept more difficult. Simulants are substances that mimic the significant characteristics of chemical, nuclear, biological or explosive payloads carried by threat missiles. Countermeasures

and simulants are also used to support the development and testing of the BMDS. They are programs within MDA's Measurements Program and are discussed further in Section 2.2.5.

2.2.5 MDA's Programs

The MDA implements several programs that support various aspects of the implementation of the BMDS, notably including the Advanced Systems program, the Measurements Program, and the International Program. As shown in Exhibit 2-19, the Advanced Systems program supports the development portion of the BMDS acquisition life cycle. The Measurements Program includes the Countermeasures and Corporate Lethality Programs, which support the test portion of the BMDS acquisition life cycle.

Exhibit 2-19. MDA Programs Supporting the BMDS Acquisition Life Cycle



Given the worldwide implications of ballistic missile defense, MDA also has an active International Program that includes the participation of several international partners in a variety of BMDS-related development and test activities.

2.2.5.1 Advanced Systems

The Advanced Systems program addresses research and technology improvements to enhance, supplement, or replace various building blocks or capabilities as the proposed BMDS evolves over time. Some technology improvements are currently proposed; others will evolve in the future (i.e., cannot be identified at present). Examples of current Advanced Systems projects include Project Hercules, the High Altitude Airship (HAA) and Multiple Kill Vehicles. Additional discussion of the MDA's Advanced Systems program can be found in Appendix F.

2.2.5.2 Measurements Program

To assess and characterize specific aspects of BMDS components' performance during testing, the MDA implements a Measurements Program. The program is designed to provide critical data and analyses that fulfill BMDS requirements identified and

prioritized by the Measurements Program Assessment Team. Measurements tests would be incorporated in individual component tests as well as integrated tests in laboratories, GTs of components, and during flight tests.

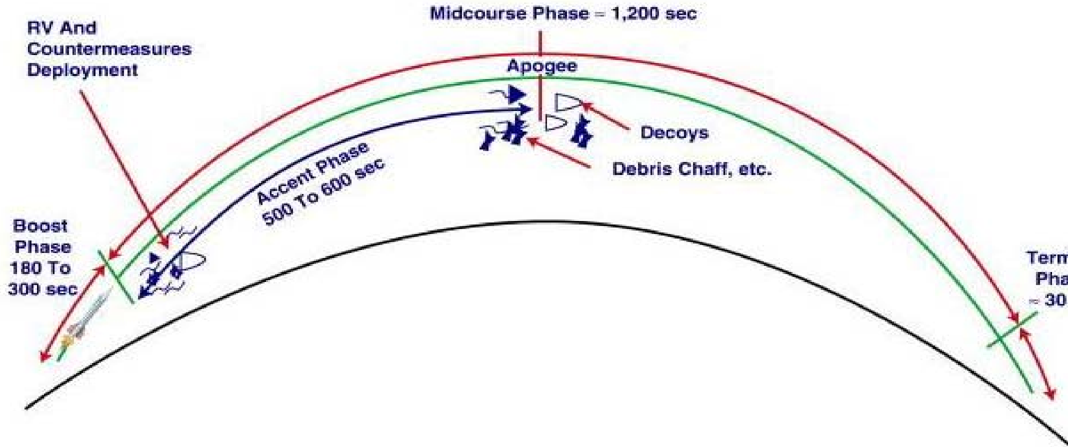
The Measurements Program would conduct critical measurements tests to collect data for all components to support system engineering assessments/performance verifications and ground effects analysis, and to characterize potential or actual countermeasures. At this time, "measurements" includes counter-countermeasures characterization, lethality, kill assessment, discrimination data, phenomenology measurements (the observation, description and explanation of the visible appearance of a test), and other critical measurements. The Measurements Program includes the Critical Measurements and Countermeasures Program (CM/CM), Countermeasure and Counter-countermeasure Program, and the Corporate Lethality Program. The CM/CM program is designed to address discrimination phenomenology, countermeasure performance, BMDS performance degradation, and potential mitigation options. The Countermeasure and Counter-countermeasure program attempts to characterize countermeasure signatures and to assess counter-countermeasure efficacy. Lethality, or the ability of the BMDS to prevent a ballistic missile threat from producing lethal effects, relies on kill assessment and other data gathered by BMDS component sensors and test sensors. Data are gathered through the Optical Data Analysis, Radar Data Analysis, and Radar Data Exploitation Programs.

Countermeasures

Countermeasures are designed to increase the probability that the reentry vehicle from a threat missile reaches its intended target. BMDS testing would include the use of robust countermeasures designed to mimic those that could be used on potential threat missiles. By testing the capabilities of U.S. interceptors against realistic targets including countermeasures the ability of the U.S. to respond to an enemy missile attack would be greatly enhanced. The specific signature and nature of the countermeasures that would be used as part of the BMDS testing activities are classified. Therefore, the discussion in this document on the potential impacts of countermeasures that would be used in BMDS testing is generic in nature.

There are two primary types of countermeasures, penetration aids or penaids and inherent countermeasures. Penaids are items that are added to the missile to increase the chance of the missile reaching its intended target. Penaids could be housed in the target reentry vehicle separation module. One penaid technique is for an offensive missile to carry, in addition to the actual target reentry vehicle, several decoy target reentry vehicles. These decoys, shown in Exhibit 2-20, when released, appear to be actual warheads. Inherent countermeasures are elements of normal operations of missiles that make it harder for interceptors to identify and destroy the target missile. This would include the separation

Exhibit 2-20. Deployment of Countermeasures during Flight Phases



of the reentry vehicle from the booster, which decreases the size of the portion of the missile to be tracked and destroyed by the interceptor.

There are various basic categories of countermeasures that could be used by MDA in characterization and in testing the BMDS. These include simulation, anti-simulation, traffic maskers/obscurants, aim point denial, and maneuver. Each uses different methods to add potential threat characteristics to targets used in the Measurements Program or in other BMDS testing.

Simulation countermeasures deploy various materials to confuse sensors and prevent them from correctly identifying the reentry vehicle. These countermeasures would primarily be fabricated from graphite, stainless steel, and tungsten. Anti-simulation countermeasures attempt to disguise the reentry vehicle by making the reentry vehicle look to the sensors like something other than a reentry vehicle. Traffic countermeasures deploy many items at once; this could include using multiple reentry vehicles or multiple countermeasures to confuse sensors. Maskers or obscurants are materials or objects that move in flight along with the reentry vehicle to confuse the sensors and prevent them from correctly identifying the reentry vehicle. Aim point denial is the ability to confuse the sensors from identifying the point on the reentry vehicle that should be hit to prevent the reentry vehicle from reaching its intended target. Maneuver countermeasures include the ability of reentry vehicles to change trajectory as they enter the atmosphere thus preventing the interceptor from predicting the path of the reentry vehicle. Other countermeasures are designed to increase the probability that the reentry vehicle reaches its intended target.

Lethality

Lethality is a measure of the ability of the BMDS to prevent a threat ballistic missile from producing lethal effects. Preventing a threat missile from completing its mission could entail the use of kinetic energy (hit-to-kill and blast fragmenting weapons) or directed energy (laser) to intercept and neutralize the target. Adequate lethality of the interceptor missile ensures the destruction of incoming enemy warheads to minimize potential threats. Lethality effects are described as either hard kills or soft kills. A hard kill occurs when damage done directly to the threat at the point of intercept results in the payload's immediate destruction. A soft kill occurs when damage done to the threat either causes the threat's destruction due to the effects of atmospheric drag/reentry on surviving payloads or prevents the payload from reaching its intended target. Lethality analyses begin at the moment of impact and continue through to interaction of the target pieces and any surviving payload contents with the Earth. The MDA is developing criteria to evaluate the lethality capability of BMDS technology against various threats. Potential enemy threats could include bulk High Explosive, High Explosive-laden submunitions, nuclear, biological, chemical, and bulk chemical payloads carried on tactical ballistic missiles.

Lethality studies include the monitoring and analysis of threat payload destruction and dispersion during intercepts of test threat targets. Although limited testing is done on actual lethal agents under controlled laboratory conditions, most of the testing relies on a number of payload simulants that, while chemically and biologically neutral, mimic the significant qualities, such as dispersion, weight, and viscosity of a toxic or hazardous substance for test purposes. Testing would require the use of existing simulants and may require the use of newly developed ones.

Because the countermeasures and lethality programs support BMDS testing, they will be considered along with other test assets (i.e., test bed, test sensors, and targets) in the analysis of impacts in Section 4.

2.2.5.3 International Programs

The MDA's mission is to develop and field an integrated BMDS capable of providing a layered defense for the U.S. homeland, deployed forces, allies and friends against ballistic missiles of all ranges in all phases of flight. To this end, the MDA supports a variety of international programs and invites international participation in its own programs. For example, the Arrow System Improvement Program is a joint undertaking with Israel, which will include technical cooperation to improve the performance of the AWS and a cooperative test and evaluation program to validate the improved performance.

2.3 BMDS Life Cycle Activities

This section describes the activities that occur during each phase of the acquisition life cycle (i.e., development, testing, deployment, and decommissioning) for BMDS components.

2.3.1 Development of BMDS Components

The MDA would develop the necessary components of the BMDS using an evolutionary spiral development process described in Section 2.1.3.2. The MDA would use existing infrastructure and components, when feasible, and would add emerging and new technologies as they become available. The components would be combined into specific configurations to achieve desired functional capabilities. Development activities would contribute to the evolution of the BMDS design as existing component configurations are altered or new configurations are created in response to evolving functional capabilities. During the development of new and modified components, environmental and occupational safety and health procedures would be developed. As outlined in Exhibit 1-3, development of BMDS components includes activities such as planning, budgeting, research and development, systems engineering, site preparation and construction, maintenance and sustainment, manufacture and initial testing of prototype test articles, and conduct of tabletop exercises.

2.3.1.1 Weapons

Weapons include interceptors and lasers as described in Section 2.2.1. Development of weapons components would build on existing infrastructure and capabilities of the BMDS elements. Research and development activities for weapons that could potentially have environmental consequences include research and development activities such as developing and testing propellant formulations for new rocket motors, developing or selecting casing materials, and developing and testing subscale rocket motors. System engineering tests such as hardware-in-the-loop tests would involve using an actual kill vehicle, intercept sensor unit, or directed energy component electrically connected to a computer system that simulates the functions of the other components of an interceptor. Repair, maintenance, and sustainment of weapons systems would include checks to ensure that system technology is still viable and cleaning, which may involve the use of solvents. Manufacturing and initial testing of prototype weapons technology may require static-fire testing of boosters or the firing of the HEL and may also involve the use of a sled (i.e., a carrier vehicle that is designed to move along a section of rail at speeds approaching missile flight velocities) to test boosters or to provide target opportunities. Tabletop exercises would allow developers to plan the interaction of a weapons system's internal technology, as well as its interaction with other components. These activities would occur at both contractor and government facilities and would include environmental and operational tests under simulated field conditions and computer simulations.

2.3.1.2 Sensors

The development of sensors would build on existing sensors and infrastructure including the current development efforts for radars such as X-band, S-band, L-band, C-band, and infrared, optical, and laser sensors as described in Section 2.2.2 and Appendix E. The types of activities involved in developing sensor components would include planning, budgeting, research and development, systems engineering, repair, maintenance, and sustainment, manufacture and initial testing of prototype test articles, and conduct of tabletop exercises. Research and development of mobile systems might include transportability demonstrations, possibly using aircraft and ground transport. All other development activities for sensors would be similar to those required for weapons. For example, systems engineering tests would include environmental and operational tests under simulated field conditions and computer simulations. These activities would occur at both contractor and government facilities and would include environmental and operational tests under simulated field conditions and computer simulations.

2.3.1.3 C2BMC

C2BMC includes the hardware and software and related infrastructure that connects and integrates the BMDS as described in Section 2.2.3. Development occurs in close conjunction with the weapons and sensors components described above and would utilize the existing assets and infrastructure when feasible. Development activities would include planning, budgeting, research and development, systems engineering, repair, maintenance, and sustainment, manufacture and initial testing of prototype test articles, and tabletop exercises.

For purposes of this PEIS, analysis of the environmental impacts associated with the installation, construction, or manufacture of C2BMC equipment and facilities will be considered, including computer terminals and displays (hardware) and the necessary computer programs (software) to provide BM and C2 functionality. C2BMC improvements may include simple software upgrades, updated computers, new facilities, buried communications cable, and, possibly, construction of new centers. Additionally, the analysis includes communications assets such as military and commercial satellite communications (COMSATCOM) terminals and antennas, radio communications terminals and antennas, and above- and below-ground communications cables (e.g., fiber optic and copper). A satellite communication system would provide satellite communications among C2BMC nodes. The satellite system would consist of satellite terminals, equipment buildings housing communications enclosures, backup power and dish antennae. The In-Flight Interceptor Communication System Data Terminal (IDT) is a part of the C2BMC and provides an in-flight communications link between nodes and interceptors. If a new satellite system or IDT system would be required, impacts would result from building construction and launch of the satellites. Fiber optic cable uses light pulses to transmit information along fiber optic lines. Where new fiber optic cable is

required, cable may be installed on either side of existing rights-of-way (e.g., normal roads or railroad tracks). Typically, fiber optic cable would be buried to a depth of approximately one meter (three feet) from the surface.

2.3.1.4 Support Assets

Support assets as described in Section 2.2.4 are the mobile and fixed auxiliary equipment, vehicles, and facilities that are needed to support and facilitate the operation and on-going evolution of BMDS components and testing of the system. Development of support assets including test assets for the BMDS would be closely coordinated with the development of the weapons, sensors, and C2BMC components. Planning for future support assets is critical to ensuring that they are acquired in time to meet the needs of upcoming BMDS components.

BMDS Test Bed

The BMDS Test Bed would encompass the infrastructure and environment where testing takes place. Development of the Test Bed would focus on planning for and acquiring infrastructure that enables realistic testing by permitting realistic geometries for sensor viewing and interceptor engagements. The proposed Test Bed includes test locations already being used, such as GT sites, or already developed, such as the GMD ETR in the Pacific Ocean. The MDA may also expand the Test Bed to include other areas in the Atlantic Ocean, Gulf of Mexico, outside the continental U.S., and ultimately a space-based test bed to support robust and realistic testing of BMDS components in those areas. The MDA would use existing sensors and launch facilities along the Atlantic and Gulf coasts to evaluate phenomenology and interoperability of sensors. Exhibit 2-21 lists the facilities in the Atlantic or Gulf of Mexico that are currently used for MDA activities or may be used in the future and could be eventually included in the BMDS Test Bed. Some facilities are independent, and others fall under the jurisdiction of a Range. Those installations that are under the jurisdiction of a Range are presented beneath that Range. The MDA would use launches from NASA and U.S. Air Force (USAF) facilities as targets of opportunity to reduce the number of MDA launches required.

Exhibit 2-21. Facilities Available in the Atlantic or Gulf of Mexico

Facility	Location
Gulf Test Range/Eglin AFB	Florida
Cape San Blas	Florida
Santa Rosa Island	Florida
Mobile Sea-Based Platform	Broad Ocean Area (BOA)
Eastern Test Range/Cape Canaveral Air Force Station	Florida
Mobile Sea-Based Platform	BOA
NASA Kennedy Space Center	Florida
Tyndall AFB	Florida
Space Port Florida (Florida Space Authority)	Florida
ISTEF – Merritt Island	Florida
Mobile Sea-Based Platform	
Cape Cod Air Station	Massachusetts
Hanscom AFB	Massachusetts
Lincoln Space Surveillance Complex	Massachusetts
Redstone Arsenal	Alabama
Naval Air Test Center Patuxent River	Maryland
Aberdeen Proving Ground	Maryland
Ocean City Municipal Airport	Maryland
NASA Wallops Flight Facility	Virginia
Newport News Municipal Airport	Virginia
GBI Development and Integration Laboratory	Alabama
Stennis Space Center	Mississippi

Test Sensors

Development of test sensors, as described in Section 2.3.1.2, would include activities similar to those that would occur in the development of the BMDS mission sensors and BMDS element sensors.

Targets

Preparing targets for flight test events would involve designing, prototyping, developing, procuring, certifying and qualifying them. Targets would be developed in response to the needs of BMDS and element testing requirements. To reduce costs, several targets would use retired components from other programs, including the U.S. Army Pershing II program, U.S. Navy Polaris program, Trident-1 (C-4), and U.S. Air Force Minuteman II program, as well as some Foreign Material Acquisitions. This practice would not only reduce the amount of raw material used but would also limit the amount of production

needed to develop realistic threat targets. These retired components may be used in their original configuration, or may undergo minor reconfiguration, depending on the specifications of the test. Every target system currently built meets unique test requirements; therefore, production of target systems is item-by-item and not in quantities. MDA is developing a family of targets to provide a standard target missile to support short-, medium-, and long-range test requirements.

Advanced target applications in progress include short- and long-range air-launched targets and liquid fuel boosters, as well as a multi-mode medium-range target. MDA is developing a family of targets that provides standard target missiles to support short, medium and long range test requirements. Mobile launch/basing platforms are being considered, along with the development and future procurement of advanced countermeasures and payloads.

Countermeasures

Development of countermeasures would involve detailed planning for test events, and identifying test objectives, appropriate countermeasures and counter-countermeasures, and acquiring any necessary materials.

Two types of defensive measures would be used to oppose countermeasures. The first would be improving sensor technology to more completely discriminate between the reentry vehicle and any deployed countermeasures. During the development of flight tests involving countermeasures, appropriate sensors would be selected and scheduled to participate in the test event. The second defensive measure would be improving interceptor technology to increase the chance that the interceptor can correctly identify and destroy the reentry vehicle. Development activities would include modeling and simulation as well as ground testing to characterize physical properties of countermeasures and predict behavior during flight tests.

Lethality

Assessing lethality involves the use of chemical or biological simulants that, while chemically and biologically neutral, mimic the significant qualities of a toxic or hazardous substance for test purposes. Development of simulants would involve research and planning, identification of neutral or inert substances with the required physical properties for specific tests, and in some cases manufacturing significant quantities of the simulant.

2.3.2 Testing of the BMDS

Testing is a critical aspect of the BMDS life cycle and under the spiral development process would occur simultaneously with the development and deployment periods of the life cycle acquisition process. Testing allows for the life cycle of all BMDS components to be closely correlated so that efforts in particular areas of the BMDS may be truncated or canceled if the results are unsatisfactory or where the development effort should be shifted to another integrated BMDS element to permit acceleration.

Testing will require several basic activities as outlined by component in Exhibit 1-3. Weapons, sensors and C2BMC components would be manufactured specifically for a test event, and appropriate site preparation and construction would be conducted at the test location. Infrastructure in the Test Bed would be constructed and prepared and components transported to the site, as necessary, and interceptors and targets would be assembled and fueled. Where necessary, sensors would be assembled before activation. The appropriate occupational safety and health procedures and appropriate training would be developed and followed for these activities.

Testing occurs at the component (Section 2.3.2.1), element (Section 2.3.2.2), and system (Section 2.3.2.3) levels. The goal of BMDS testing is to demonstrate integrated and effective functioning during increasingly complex and realistic engagement sequences. An engagement sequence is a unique combination of detect-control-engage functions performed by BMDS components (such as sensors, weapons and C2BMC) used to engage a threat ballistic missile. The C2, BM, and fire control functions enable the engagement sequence. Individual component and element tests are required to demonstrate the functionality of BMDS technology. Element tests evaluate the ability of component configurations to work together. These tests are the beginning of integrated BMDS tests. Some components may not be designed to be a part of an element (e.g., upgraded EWR). In those cases, the component would move from component level testing directly into System Integration Tests. See Section 2.3.2.3 for description and discussion of System Integration Tests. Integration testing is the activity that occurs above and beyond that which is required during the demonstration phase for each component or element. Integration system testing assesses the ability of BMDS components to work as a unit and to meet the required functional capabilities of the system.

2.3.2.1 Component Tests

The following describe the test activities that would be performed for each of the components in the proposed BMDS.

- **Weapons.** Weapons testing activities for interceptors would include the static firing of rocket boosters, sled tests, and isolated flight tests to confirm booster function (for single and multiple stages). For lasers, testing would demonstrate laser function and individual operation of laser-related components**.**

- **Sensors.** The primary objective of sensor component testing would be to evaluate performance in detecting and tracking surrogate threat ballistic missiles. Tests would utilize targets of opportunity, that is, launches supporting other research programs. Performance would be evaluated by comparing observed and predicted performance on target detectability, measurement accuracy, and tracking accuracy. In general, test objects representative of the reentry vehicles and countermeasures would be required to support both development and operational test and evaluation activities.

- **C2BMC.** The C2BMC must receive, fuse, and display tracking and status data from multiple components and coordinate firing/launches and intercepts. Testing would involve modeling and simulations to assess hardware and software capabilities and to demonstrate interoperability prior to participation in test events. C2BMC components would be tested in concert with their corresponding weapons and sensors components.

- **Support Assets.** Testing of support assets (including test assets) is discussed separately following the discussion of System Integration Tests. This includes the discussion of MDA Measurements Program countermeasures and simulants testing as part of test assets.

Testing of individual components has been largely addressed in existing NEPA analyses as listed in Appendix C, Related Documentation.

2.3.2.2 Element Tests

Element tests are required to evaluate the ability of component configurations to work together. Descriptions of element test activities and status by block are described in Appendix D, Descriptions of Proposed BMDS Elements. Testing of individual elements and support asset components have been largely addressed in existing NEPA analyses as described in Appendix C, Related Documentation.

2.3.2.3 System Integration Tests

The MDA is proposing to perform integration test activities on existing and planned components such as sensors, weapons, and C2BMC equipment. Integration testing of BMDS components provides system characterization, verification and assessment. Integration testing assesses the ability of BMDS components to work as a unit and to meet the required functional capabilities. Ongoing demonstration activities are required to assess a component’s continuing utility within the system. System Integration Tests

would be used to demonstrate BMDS performance. System Integration Tests rely on a foundation of individual component tests and culminate in SIFTs. This section describes typical flight test activities, the approach and descriptions of integration test events, and the contribution of the MDA's BMDS Measurements Programs to the assessment of technological capabilities.

Typical Flight Test

A typical weapons flight test would involve the use of a simulated airborne target, the use of a drone, or the launch of a target missile, the launch of an interceptor missile or the firing of a laser, and the intercept of the simulated threat missile target. Flight-testing also would provide measurements on the effectiveness against countermeasures and the lethality of the kill vehicle.

The MDA would deploy personnel and assets to the test locations to prepare for the flight mission (FM), conduct the flight test, and refurbish the test sites to pretest conditions, if applicable. Prior to a test event, the target launch site(s) would generally be occupied for approximately three months before a scheduled launch and about two weeks after a launch. A typical three-month launch cycle ramp-up would include 25 people during the first month, 25 to 75 people during the second month, and 100 to 150 people during the third month. Dual target launches would include approximately 25 people during the first month, 75 to 100 people during the second month, and 150 to 175 people during the third month. After a launch, approximately 50 personnel would immediately depart, and the remaining personnel would depart after launch site refurbishment.

The MDA would launch target missiles in a manner that represents relevant adversarial capability and provides the components with opportunities to practice their function in a realistic situation. The duration of a typical test flight would vary based on the component(s) that are involved and the flight phase where intercepts would occur. Flights with a planned intercept in the boost phase would last up to five minutes. Flights with intercepts in the midcourse phase would last from about five to 20 minutes. Flights with intercepts in the terminal phase would last up to approximately 20 to 30 minutes. Airspace surveillance procedures, which would be implemented to ensure range safety, would last as little as 45 minutes or longer if the test is delayed.

After launch, the target missile would slowly gain speed in the first few seconds of flight, and then rapidly accelerate out of sight and earshot. One minute into flight, a typical target missile would be at an altitude of approximately 16 to 19 kilometers (10 to 12 miles). The first stage would burn out, and in the case of a separating target, would fall within the predicted booster impact area. The second and third stages (if used) would perform in similar manners, and the target missile would climb out of the atmosphere and into space. The reentry vehicle or non-separating target would reenter the atmosphere and decelerate until it is intercepted or until the mission is completed.

To intercept the target missile, the tracking radar would acquire and track the target while the interceptor C2 system computes the best time to launch the interceptor missile. The interceptor missile would then be launched. Approximately one minute into flight, the interceptor would be at an altitude of about 50 kilometers (31 miles) and approximately 65 to 80 kilometers (40 to 50 miles) down range. (The altitude and distance down range will depend greatly on the trajectory and type of missile.) The first stage would burn out and fall within the predicted booster impact area. The second and third stages (if used) would ignite, and the interceptor would continue along its intended path. After burnout, the second and third stages would fall into their designated impact areas. After the final stage burnout, the interceptor, or deployed kill vehicle, would continue its flight until the target is intercepted. If the intercept were unsuccessful, the interceptor or kill vehicle would be destroyed by mission control or would be allowed to return to Earth. All booster stages and interceptors would be programmed to land in predetermined and verified clear areas. Intercept altitudes could vary from approximately 100 to more than 250 kilometers (62 to more than 150 miles). (The altitude and distance down range would depend greatly on the trajectory and type of missile.)

System Integration Testing Approach

The BMDS Test Program provides for a cohesive testing program of the interoperability of all Block architecture components and elements. System Integration Tests would involve interaction between and assessment of ground-, sea-, air- and, in some cases, space-based test assets. As the BMDS evolves, System Integration Test scenarios would become more complex and realistic to evaluate the integration of a higher number of working elements and components. More realistic scenarios would introduce an increasing number of targets. In addition, critical measurements programs may start as early as the components level and go up through integration system tests.

MDA's Responsible Test Organization provides the single point of responsibility, authority, and accountability for the BMD System Integration Testing. The Responsible Test Organization manages the test bed infrastructure and collaborates with the elements and components to develop system characterization and coordinate System Integration Tests. The Combined Test Force (CTF) is the execution arm of the Responsible Test Organization that develops long range and detailed plans, provisions, executes, acquires data from and analyzes the Campaigns.

The System Integration Test planning process is driven by goals that are laid out in guidance and technical objective documents. These objectives indicate the functional capabilities that need to be met by BMDS technologies. From the overview documents, a series of more detailed planning documents outline the details of test objectives, test requirements, and scenarios for System Integration Testing. These documents would be developed and revised regularly. Combinations of components that can meet functional capabilities would be identified. Dedicated component and element tests would be

synchronized to create a System Integration Test. Supporting components are identified to maximize the amount of data that can be gathered during a System Integration Test. System Integration Tests include modeling, simulation, and analysis, missile defense wargames, missile defense integration exercises (MDIEs), integrated GTs, and one or more SIFTs. System Integration Tests may also be performed for targets of opportunity. SIFTs are the culminating test event combining all prior test activities. These testing events evaluate component and integrated system performance and readiness.

A brief description of each type of System Integration Tests is provided in Exhibit 2-22.

Exhibit 2-22. Description of System Integration Tests

Test	Description
Modeling, Simulation, and Analysis	Modeling, simulation, and analysis are used during test planning, rehearsal, prediction of test outcomes, and post-flight assessment to verify and update models.
Integrated Missile Defense Wargames	Integrated missile defense wargames are table-top or computer simulations of military operations involving two or more opposing forces, using rules, data, and procedures designed to depict an actual or assumed real-life situation.
MDIEs	MDIEs are designed to characterize interoperability and how BMDS software components communicate prior to actual test flights.
Integrated GTs	GTs are tests used to collect data for BMDS components characterization and assessment and do not include booster function flight tests. GTs aim to reproduce the existing state of BMDS architecture, typically components scheduled for upcoming flight tests, to prepare for those flight tests and to assess component performance. For the purposes of this PEIS GTs do not include activities associated with components but rather have been focused on System Integration Testing.
SIFTs	SIFTs are conducted to verify the integration of select BMDS components. These tests generally include a target launch, sensors tracking the target, laser activation or an interceptor launch, and sensors to determine whether the target was destroyed. The number of sensors, weapons, and targets used in a SIFT can be adjusted to create the desired test scenario.

Modeling, Simulation, and Analysis

Modeling, simulation, and analysis are used to provide insight on test design and potential range constraints. Models are used prior to tests to rehearse and predict the test outcomes. In the post-flight phase, models are used to assess and analyze test results. Use of models allows the actual tests to be more successful, for example, by ensuring that a test does not violate a range constraint. Modeling also allows for "overlaying," a technique to predict and evaluate a component's response to a test exercise in which it did not participate. Analysis of post-flight data also allows the validation, verification and update of models.

Integrated Missile Defense Wargames

Integrated missile defense wargames are simulations, by whatever means, of military operations involving two or more opposing forces, using rules, data, and procedures designed to depict an actual or assumed real-life situation. They are designed to gain insight into how human decision-making affects the use of BMDS components. The MDA would use wargames to confirm the effectiveness of its CONOPS. The MDA could conduct multiple system-wide wargames per year. Prior to a wargame event, the MDA would determine the necessary data requirements. Integrated missile defense wargames are tabletop and computer simulation based and do not have a field component. Actual participants attend each wargame and the results allow insight into the information exchange between the BMDS elements and components, coordination during engagement, inventory expenditures, and improvement to CONOPS. For example, prior to a Campaign, an integrated missile defense wargame would be conducted with players and observers to examine BM schemes, shot doctrines, and other operations procedures.

Missile Defense Integration Exercises (MDIEs)

MDIEs are exercises designed to characterize how BMDS software components are communicating. The MDA has developed a Missile Defense System Exerciser to support interoperability testing. Its primary purpose is to characterize the interoperability among the BMDS elements, ensuring the ability to operate as a single system. Throughout the development of the BMDS, there are frequent updates to software, particularly the C2BMC software. The Missile Defense System Exerciser allows for tests of MDA software and hardware. An MDIE would be conducted specifically to support block software integration prior to SIFTs. The MDA plans to conduct multiple MDIEs per year.

Integrated GTs

GTs are tests used to collect data for BMDS characterization and assessment, and do not include component testing activities and System Integration Tests. For purposes of this PEIS, static test firings of rocket boosters, sled tests, or booster function flight tests are considered component level GTs. Component tests have largely been addressed in existing NEPA analyses as identified in Appendix D. Those analyses that were incorporated by reference are included in Appendix C. The analysis of GT activities considered in this PEIS focuses on system integration GTs, which would provide an understanding of the BMDS component integration and assessment, as well as how each component responds in different situations. Such tests provide data on risk reduction for system flight tests and for scenario exploration where flight-testing is either impractical or impossible. System integration GTs aim to reproduce the current state of BMDS architecture, typically components scheduled for upcoming flight tests, to prepare for those flight tests and to assess component performance. The GT tool must include weapon and sensor representations to do system performance testing and must be connected to a test bed as well as other deployed systems.

System Integration Flight Tests (SIFTs)

SIFTs measure BMDS component interoperability and assessment of BMDS functional capabilities in each developmental Block. SIFTs are the culminating test event that relies on testing activities such as integrated missile defense wargames and MDIE test events discussed above. They involve interaction between and assessment of ground-, sea-, air-, and, in some cases, space-based components. Each of the SIFTs incorporates dedicated component and element tests scheduled to occur at the same time. For example, testing of a specific interceptor would be synchronized to occur with the dedicated test of separate radar. The MDA plans to conduct up to two SIFTs per year.

Additional test components could be included in a SIFT to support data collection and overlays. For example, during a dedicated test of GMD’s ability to track and intercept a threat missile, the Aegis SPY-1 radar could be used as a forward sensor to track threat missile trajectory and relay it to the GMD interceptor. Any number of extra sensors could be tested during the SIFT to confirm other sensors’ tracking data. Overlaying is a technique to predict and evaluate a component’s response to a test exercise in which it did not participate. For example, the response of a PAC-3 interceptor to a threat that a THAAD interceptor actually engaged can be modeled to generate additional data and predictions.

Planned System Integration Tests

The MDA has planned a series of System Integration Tests to evaluate the status of the BMDS and its components. Activities conducted during a System Integration Test

include the planning of integration tests, production of components and support and test assets, and implementation of actual flight tests.

Targets and Countermeasures activities for Block 2004 would include the development of full-up target systems to support BMDS and element testing; development of payload suites for CM/CM flight tests and target risk reduction flights; and the maintenance, surveillance, refurbishment and routine testing of existing Government Furnished Equipment boosters.

The MDA plans to conduct a series of additional System Integration Tests to test the BMDS capabilities in Block 2004 and beyond. System Integration Tests represent independent flight tests that leverage from existing element or component tests. Future block testing would be planned and developed to meet the needs of the BMDS at the time of testing. Therefore, details of these integrated test events are only conceptual at this time. The general objectives and investment priorities for future Blocks include testing and validation efforts with a focus on integrated flight tests, with added realism and more stressing threat countermeasures. The BMDS layered defense is envisioned to be developing a strong boost phase intercept capability.

This PEIS examines the range of System Integration Test events as planned and described above. However, of the System Integration Test events, the GTs and SIFTs represent the most realistic testing scenarios. GTs involve the simultaneous activation of multiple sensors and C2BMC components, which would coordinate the control and transfer of information between weapons. A SIFT combines a range of test activities into a single test event that may occur over several days. SIFTs are designed to be increasingly complex integration tests over time. GTs and SIFTs are the only System Integration Tests with a field component and thus have the broadest range of potential environmental consequences. The example SIFT scenario described below is designed to capture the range of environmental effects that could occur from increasingly complex integrated testing of the BMDS. This example is meant to show a representative SIFT that could be conducted as part of the Proposed Action; it is not meant to be inclusive or exclusive of testing possibilities or launch trajectories.

Generic SIFT

A generic example of a SIFT would comprise initial selection of a launch and intercept of a single threat missile. In general, targets and interceptors would be launched from sites in the Test Bed. As a threat missile was launched, specific sensors would be tasked with acquiring and tracking the boosting threat missile and passing cueing information through the C2BMC to other sensor and weapon components. As the threat missile enters its midcourse phase, tracking responsibilities might be transferred to another component designed for that phase of flight. Additional cueing information would be passed again through the C2BMC to interceptor components. The threat reentry vehicle would be

identified and an interceptor launched. Intercepts would occur over designated land areas and BOAs. Once the threat had been intercepted, the component would perform a hit assessment and notify C2BMC of the results.

For example, a representative SIFT could include the GMD element engaging an ICBM long range target in the boost phase, with Aegis BMD acquiring and tracking the target from another location and sending the data to GMD. At the same time, Aegis BMD could engage a different target in the midcourse phase, with ABL acquiring and tracking the target during the boost phase. THAAD could engage another target in the terminal phase, coordinating with PAC-3 to identify the reentry vehicle. Additional components and elements could participate, by using the event as a target of opportunity (TOO) to validate their system performance.

Using information gathered during the SIFT; overlay scenarios would be constructed for other interceptor components. These scenarios would provide the ability to assess the capacities and limitations of each component in intercepting the threat without additional flight tests. Simulation overlays would also serve as a risk reduction in the integration of the components into the BMDS.

Future System Integration Tests

As discussed previously, System Integration Tests are designed to measure BMDS component interoperability and to assess BMDS functional capabilities. As the BMDS evolves to meet emerging threats, System Integration Tests must reflect the increasing number of integrated components. System Integration Tests become more complex as those components occupy more geographically diverse locations. Modeling, simulation, and analysis; MDIE; and integrated missile defense wargames are virtual tests (modeling and computational analyses) or software compatibility and communication tests that would be conducted within existing laboratory or test facilities. GTs involve the simultaneous activation of multiple sensors and C2BMC components, which would coordinate the control and transfer of information between weapons. However, SIFTs could involve the launch of targets and firing or launch of interceptors in addition to the participation of multiple sensors and C2BMC components.

SIFT scenarios attempt to capture more realistic intercept parameters. For purposes of this analysis, two representative scenarios that could be used during SIFTs under Alternatives 1 and 2 were considered. These two scenarios involve similar activities (launches of targets, use of multiple sensors, and use of land-, sea-, air-, and for Alternative 2 space-based weapons); however, they differ in number of target launches and number of weapons used. Both SIFT scenarios may be used to support the proposed BMDS and are analyzed in this PEIS.

SIFT Scenario 1 represents the simplest SIFT and would include the launch of a single target and use of a single weapon component to intercept the target. This scenario would use multiple sensors and C2BMC components. Under SIFT Scenario 1, the launch of the target and the activation of a laser or launch of an interceptor may occur within the same biome or may involve multiple biomes. As BMDS capabilities are proven, a second SIFT Scenario (*SIFT Scenario 2*) is envisioned that would build upon SIFT Scenario 1.

SIFT Scenario 2 would include the launch of up to two targets. For each target launch, more than one weapon component would be able to engage or "take a shot" at the target. Dual-target or interceptor launches would occur within seconds or minutes of each other. As with SIFT Scenario 1, numerous sensor components also would acquire the target and relay tracking data. Under this test scenario, the two targets may be launched from one biome and the weapons may be activated or launched from the same or different biomes.

SIFT scenarios are confined by geographic as well as range constraints that limit the number or types of launches that can occur at a specific location based on infrastructure and allowable debris impact zones. Each facility has either physical limits or regulatory limits on the number of simultaneous launches that it can execute. Test objectives also would limit the types of targets, countermeasures and simulants used.

The MDA would conduct future SIFTs in the existing or an expanded Test Bed. The current Test Bed is based around the Pacific Ocean. However, additional test facilities along the Atlantic Ocean and Gulf of Mexico as well as components located outside the continental U.S. may also be used.

2.3.2.4 Role of Test Assets in Integrated Testing

The MDA would use test assets to enhance the BMDS by simulating a threat missile in a realistic environment. Specific target missiles would be configured to meet the objectives of a SIFT scenario. Test assets would also support integration testing by providing infrastructure needed to assess the performance of components and systems, e.g., non-BMDS test sensors and telemetry may be used to acquire, record, and process data on targets and interceptors during testing.

Test Bed

The BMDS Test Bed would provide opportunities to use several target and interceptor missile trajectories that encompass a range of missile threats. Test Bed activities would help wargames prove out doctrine; operational concepts; tactics, techniques, procedures; and CONOPS in militarily relevant environments. Components of the Test Bed provide

IDC.[30] The IDC is comprised of the technical capabilities (hardware and software) of the BMDS available for operations on September 30, 2004. After the Combatant Commander has completed the requisite planning and the operators have been trained, qualified and certified to effectively employ the IDC equipment, along with the supporting integrated logistics and training systems, the components will constitute IDO.

Test Sensors

The primary objective of test sensor testing is to evaluate performance in detecting and tracking surrogate threat ballistic missiles. Tests would use targets of opportunity (TOO) as well as BMDS targets. Performance would be evaluated by comparing observed and predicted performance of the test sensor's ability to detect the target, accurately measure and track the target, and discriminate the reentry vehicle from countermeasures. In general, test objects representative of the threat ballistic missiles, reentry vehicles, and countermeasures would be required to support both development and operational test and evaluation activities for test sensors.

Targets

Target missiles are tested individually in risk reduction flights, to demonstrate their flight capabilities and ensure their safe operation. They are also used to test the capability of sensors. In interceptor tests, targets are used to test the coordination of the sensors, interceptors and C2BMC in completing a successful intercept. In some instances, the objective of the test event is to track and destroy the target with the defensive interceptor. Targets are also involved in flight tests as TOO. Tests using TOO rely on launches supporting other programs. In this instance, another program would participate in a passive role in a flight test, perhaps testing the ability of its sensors to track the target and communicate its properties to the appropriate ground control.

Flight-testing would be performed to verify performance and to test the interceptor's ability to engage and destroy target missiles under realistic conditions. Certain tests would involve only the acquisition of the target missile by the interceptor's seeker/sensor, while in other tests the target missile would be destroyed. In all cases, safety analyses would be conducted to ensure human health and safety are maintained and to avoid or minimize the possibility that any debris would cause harm to environmentally sensitive resources. Typically, several flight tests are conducted within a given test program.

Targets are transferred to their test locations by air, barge, and/or over-the-road truck for system assembly and checkout. Some missile components may be shipped to an airfield near the launch site and transferred to the launch site by local truck. Once target missiles

[30] IDC refers to the sensors, C2BMC, and weapons from Block 04 that are available for limited, militarily useful capability by September 2004. The IDC will include early warning and tracking sensors based on land, at sea, and in space, C2, and GBIs for midcourse and terminal intercepts.

reach the test range and are assembled, an appropriate Explosive Safety Quantity Distance (ESQD) would be established and maintained around facilities where ordnance would be stored or handled. Target missile launch preparation at ground launch sites may include the following activities: construction and/or modification of facilities and infrastructure to support launch preparation and flight test activities; fueling of liquid targets; transportation, handling, and storage of target missile system components and assemblies; assembly and maintenance of target missile and support equipment; and checkout and testing of target missile system components and assemblies.

Activities associated with ground, air, and sea launched targets differ based on the launch platform. In general, target missile operations at the test site may include missile assembly and checkout, maintenance, final inspections, testing and checkout for the reentry vehicle, and placement of the target on the launch pad.

Ground Launch Targets

Land launches of target missiles would be accomplished from a launch pad, launch stool, silo, or runway. Missiles would be assembled and checked out and erected on the launch stool or the pad or transferred to a launch silo before a scheduled test launch. Unmanned aerial vehicles or drones could also be used as targets. Drones can use a variety of engines including turbojet engines and gasoline powered combustion engines. Each missile storage or processing facility would have an ESQD established around it. Before a launch, a Launch Hazard Area (LHA) would be established. The LHA is the area that could be affected by missile debris should an explosion occur on or just above the launch area or in the event that the missile's flight must be terminated on the pad or just shortly after liftoff. This LHA is cleared of all non-mission essential personnel during launch operations to ensure personnel are not exposed to missile launch hazards.

Air Launch Targets

Air launches of target missiles may include target drones as described above for ground launch targets. However, for purposes of this analysis a typical Air Launch Target missile would use solid propellant boosters. The rocket motors for Air Launch Targets would be shipped from U.S. Government or contractor facilities by truck or air. Other components, such as the target/pallet assembly, would be shipped as applicable. When the target arrives at the test location, the motors would be assembled and the FTS installed and integrated with other components. The target reentry vehicle would be attached to the booster; then the booster, pallet and sled assembly, and support equipment would be loaded onto the aircraft.

Air Launch Targets would be launched from specifically configured U.S. Air Force cargo aircraft. Various target missile configurations could be used depending on the range needed for the particular test. The integrated target/pallet assembly would be loaded into

the aircraft and flown to a predetermined drop point. The target/pallet assembly would be pulled from the aircraft by parachute and dropped to a level between approximately 6,096 and 7,620 meters (20,000 and 25,000 feet) above mean sea level (MSL). The target would separate from the pallet and then descend via parachutes to approximately 4,100 meters (13,450 feet) above MSL. At this altitude, the parachutes would release the target, and motor ignition would occur during free-fall. After firing, the boosters would drop into predetermined areas in the ocean. The target would then follow its flight path to interception or to splash down within a designated ocean impact area. The target would be fitted with an FTS to terminate the flight if unsafe conditions develop.

Sea Launch Targets

Sea launches of target missiles would be conducted using specially configured missiles and any one of a number of sea-based platforms. The Sea Launch Target missile would consist of solid or liquid propellant boosters. The liquid propellant boosters can be either pre-fueled or non-pre-fueled. Target missiles and support equipment would be transported from U.S. Government storage depots or contractor facilities in accordance with Department of Transportation (DOT) regulations. They would be placed in secure storage until assembly and launch preparation. Applicable safety regulations would be followed in the transport and handling of hazardous materials. An appropriate ESQD would be established and maintained around facilities where ordnance is stored or handled.

Countermeasures

In Block 2004, the MDA would conduct activities that would contribute to the use of countermeasures in future Blocks. Dedicated flight tests of CM/CM, CM/CM-1 and CM/CM-2, would be conducted to support Block 2006/2008 system definition. During Block 2006 work would continue to improve existing countermeasure capabilities and provide new capabilities including development of payload suites for CM/CM flight tests and target risk reduction flights. The work completed during Block 2008 would represent a major step in the BMDS evolution. As target development matures, capability-based targets and payload suites (to include new and more complex countermeasures) would be developed, tested, and integrated into the BMDS testing program. The technical details for Block 2010 are less defined than near-term Block efforts however, it is expected that progression on the development and use of increasingly realistic countermeasures would be incorporated into the BMDS testing activities.

Lethality

Lethality studies include the monitoring and analysis of threat payload destruction and dispersion resulting from intercepts of test threat missiles. Although limited testing is done on actual lethal or live agents under controlled conditions (i.e., in a certified

laboratory environment), the majority of testing relies on a number of payload "simulants." Testing would require the use of existing simulants and may require the use of newly developed simulants.

The MDA divides lethality into four areas of interest. The first is target response, which analyzes the actual ballistic missile intercept of a threat. The second is the formation of the debris cloud containing both pieces of the target and any payload surviving the intercept. The third looks at the atmospheric conditions for transport and dispersion of the debris cloud. Last, the lethality program examines where and how much of the debris, especially the payload, impacts the Earth.

Lethality tests include investigating the impact of the intercept of various threat payloads at various altitudes and speeds. This involves using a mix of laboratory experiments, field tests, flight tests of opportunity, models, and hydrocode simulations and computational analysis. One critical objective of lethality testing is to calculate weapons of mass destruction intercept effects and consequences. Intercepts would occur in the boost phase of target flight or in the endo- or exoatmosphere. Therefore, the altitude and speed of intercepts may affect the effectiveness of an intercept and fate and transport of threat payloads. Because the nature of an incoming threat payload is unknown, lethality testing would assist in establishing a methodology to allow warhead typing based on impact response.

Simulant payloads would be incorporated into targets already scheduled to participate in BMDS element and system flight tests. This "piggy-back" method of data collection allows for the observation of tests of opportunity and the gathering of post-engagement lethality information. Analysis would be done to determine the damage done to submunitions (for both high explosive and chemical payloads) from interceptor missile impact. Submunitions are individual containers in the target designed to distribute a threat payload to a wider area. Multi-wavelength sensors would be used to track and characterize the resulting intercept debris cloud and its eventual impact on the ground.

Testing would also include the study of lethality enhancers, which aim to increase the kill radius of an interceptor missile. Examples of lethality enhancers could include additional explosives or tungsten pellets that explode out of the interceptor upon impact. In some cases, the additional explosives are included in the interceptor missile's FTS. Data collected from these tests would be used to continue to refine existing core lethality models. These studies are currently being conducted at federally funded research development centers, academic institutions, and DoD facilities in the U.S. and abroad. Simulated bulk chemicals can be dispersed upon impact with the interceptor and/or by using an explosive device. Using an explosive charge in the payload can enhance the dispersion of the chemicals, and thereby reduce the concentration of the simulant before it reaches ground level. In the event of a missed intercept, a termination device may be used to disperse the chemicals.

In Block 2004, the MDA would focus on resolving lethality questions and concerns for bulk chemical targets with simulants while transitioning to a greater focus on validating physical phenomena with full-scale flight-test data. This would include activities such as collecting data and analyzing various chemical agents and their simulants. Experiments would investigate the in-situ negation and breakup of simulants with a focus on boost and terminal phase intercepts. Lethality tests in future Blocks have yet to be determined but would involve similar tests based on prior block experiences and individual component and integrated testing plans.

2.3.3 Deployment of the BMDS

The U.S. would incrementally expand the functional capabilities of the BMDS by deploying components and elements as testing demonstrates that they are sufficiently capable of defending against threat ballistic missiles. Generally, a component would be deployed after it has been sufficiently developed and tested to demonstrate that it is capable of operating successfully within an integrated BMDS and the associated safety and health procedures are developed and deemed adequate.

The DoD is planning to use Missile Defense Test Bed assets to defend the U.S. when it has been determined that they provide a militarily useful defensive capability. However, the MDA could deploy individual developmental assets on an emergency basis, may field elements in limited numbers should it be determined that the prototype or test article had the potential to provide a militarily useful and sustainable capability, or the asset could be deployed if directed in support of national interests.[31] Components deployed on an emergency basis would function as partially integrated components of the BMDS until the emergency situation ends.

Deployment involves a series of actions to prepare the component or element to function in its defensive position and maintain a state of readiness to address missile threats. Deployment would involve fielding and sustainment activities as described below.

Development activities include acquiring components and planning for possible transfer to military services. As the missile defense acquisition agency, the MDA would be responsible for the purchase of developmental components and engaging the military services and Combatant Commands regarding their uses and sustainment. DoD decides that a military service will engage in component production with procurement funds. The MDA, through its development contractors, could build or assemble the component and the associated support assets needed for operation in the field. The MDA would engage the operating Combatant Command and the military service in transition planning to address roles and responsibilities regarding timing, resourcing, and other requirements.

[31]On December 17, 2002, President Bush directed the fielding of IDO capabilities by 2004, which would provide limited protection to defend the U.S. against ballistic missile attack. In October 2004, MDA achieved LDC when certain BMDS test components could also be placed on alert and used in defensive operations.

The military service and MDA would agree in writing on roles and responsibilities regarding the fielding of the components to include the preparation of the deployment site, transport of the component to the deployment site, installation and test in a field environment, and staffing the deployment sites. Preparing the deployment site includes facilities acquisition and related logistics functions that might be required to support the component in its fielded state. DoD direction to transfer the component to a service would establish the functions performed by MDA, the military service, and the Combatant Command(s). In the absence of an agreed to transition plan, or a DoD transfer decision, the MDA would operate and maintain the component.

Sustainment includes various maintenance and operating activities, including maintaining components in a ready state by conducting routine maintenance, repairing damaged or defective parts, testing the component's readiness, and resupplying the component with necessary materials. Component upgrades and service life extensions, as well as training operation personnel, also are sustainment activities.

Future deployment of BMDS components would occur at times and places where the deployed component would provide the most useful defensive capability to counter existing or emerging threats. This could include sites outside the continental U.S. The following subsections discuss potential deployment actions associated with each aspect of the deployment process (acquiring, fielding, transfer, and sustainment) that are considered in this PEIS.

2.3.3.1 Fielding BMDS Components

The MDA or a military service would obtain components for deployment by purchasing the components and their parts, and assembling the parts either on site or in an assembly facility, by transferring unused units originally planned for testing, or by ordering additional units from the manufacturer. Generally, the components would be manufactured by the same contractor and assembled in the same facilities where the units were manufactured and assembled for the testing program. However, the MDA or a military service would acquire the components from other sources if the existing contracts expire and a subsequent contract is awarded to another successful offeror. This PEIS assumes that components continue to be built by the existing development contractors at the same facilities because predictions of contract changes are speculative. All manufacturing would be conducted at facilities that are subject to Federal, state, and local environmental regulations. Construction of new facilities would be subject to all applicable requirements of NEPA, EO 12114, and other relevant Federal, state, and local environmental laws and regulations, as appropriate.

Fielding would include construction of facilities, transportation and installation of equipment, and training with the integrated components of the proposed BMDS.

Deployed components would be fielded at a number of locations to provide an integrated and evolutionary BMDS. Additional capabilities would be added to expand the BMDS as the technology develops. Components would be fielded at locations where they provide a layered defense against all phases of missile flight. Boost phase defense components would be fielded where they can operate in close proximity to potential threat missile launch sites. Midcourse defense components would be fielded at locations near potential missile flight paths. Terminal defense components would be fielded near theaters of operation, near major U.S. cities and other potential targets, and on allied territory.

The MDA or a military service would field components as directed by the DoD to provide a BMDS to counter a wider range of threats. Fielding of components requires several actions to move personnel and materials to the fielding site, prepare the site, place the component at the site, and to activate the component. Exhibit 2-23 summarizes typical fielding activities for the potential platforms.

Exhibit 2-23. Typical Fielding Activities

Platforms	Components	Typical Fielding Activities
Fixed and Mobile Land-based	Weapons, Sensors, C2BMC, Support Assets	▪ Site layout and clearing ▪ Facility construction, operation and maintenance ▪ Utility construction (electric, water, sewer, fiber optics, etc.) ▪ Material transport (truck, rail, air, ship) ▪ Waste management ▪ Human services (lodging, eating, work space)
Fixed and Mobile Sea-based	Weapons, Sensors, C2BMC, Support Assets	▪ Facility (e.g., dock, port) construction, operation and maintenance ▪ Utility construction (electric, water, sewer, fiber optics, etc.) ▪ Material transport (truck, rail, air, ship) ▪ Waste management ▪ Human services (lodging, eating, work space)
Mobile Air-based	Weapons, Sensors, C2BMC, Support Assets	▪ Airport and support facility construction, operation and maintenance (e.g., chemical plant) ▪ Utility construction (electric, water, sewer, fiber optics, etc.) ▪ Material transport (truck, rail, air, ship) ▪ Waste management

Exhibit 2-23. Typical Fielding Activities

Platforms	Components	Typical Fielding Activities
		▪ Human services (lodging, eating, work space)
Mobile Space-based	Weapons, Sensors, C2BMC, On Ground Support Assets	▪ Weapon or sensor construction ▪ Material transport (truck, rail, air, ship) ▪ Rocket launch ▪ Support facility construction, operation, and maintenance

In conjunction with combatant commanders, the MDA is planning to activate test assets (e.g., missiles, launchers, sensors, and C2 components) to provide continuous or near continuous defense of the U.S. The ongoing activities in support of the IDO at Vandenberg AFB and Fort Greely are illustrative of the site preparation activities that would be performed by the MDA when a component is fielded. The IDO fielding activities, and future fielding activities, would use existing facilities and infrastructure to the extent possible to minimize new construction. Site preparation at the two locations includes

- Construction of new or modified launch facilities and silos;
- Installation of sensors, fire control center, and C2BMC facilities;
- Development of missile assembly and launch preparation facilities;
- Development of facilities to store liquid propellants (fuel and oxidizers) and hazardous wastes;
- Installation of communication cables in existing conduits or new trenches, sensor hardstands, and antennae;
- Upgrade of electric power lines, installation of backup generators, and upgrades to water and sewer hookups as needed;
- Modification of existing or construction of new buildings to provide storage, maintenance, administrative space, security facilities, and housing;
- Upgrade of existing roadways and parking facilities, and
- Installation of security equipment.

The DoD transferred the PAC-3 program and realigned the MEADS program from MDA to the Department of the Army on February 5, 2003. As part of that transfer and realignment, MDA retained the responsibility for further research, development, test and evaluation, target development, future Block capability flight-testing, and software improvements to improve and maintain interoperability with C2BMC. This PEIS assumes that the MDA would retain similar responsibilities during future transfers to the military services.

2.3.3.2 Sustainment of BMDS Components

Sustainment of BMDS components includes operation, maintenance and repair, upgrades and service life extensions. MDA would operate deployed components until they are transferred to a service. Operation would include the consumption of fuel and power and generation of wastes. MDA and/or contractor personnel would conduct routine maintenance and repair on deployed components prior to transfer to a service. After transfer to a service, sustainment of components would be the responsibility of the appropriate service. Routine maintenance would primarily occur at the fielding location unless safety or environmental constraints necessitated a change in location.

2.3.4 Planning for Decommissioning of the BMDS

Decommissioning would involve the planning for the final demilitarization and disposal of the BMDS components and support assets no longer needed for the BMDS or its testing program. Decommissioning occurs when components reach the end of their effective service life, when technological advances render them obsolete, or when changes to the threat environment render them unnecessary at a location. Demilitarization is the act of destroying a system's offensive and defensive capabilities to prevent the equipment from being used for its intended military purpose. Demilitarization of the components would be performed in accordance with the DoD Directive 4160.21-M, *Defense Reutilization and Disposal*; DoD Directive 4160.21-M-1, *Defense Demilitarization Manual*; procedures developed by MDA or the responsible military service; and applicable Federal, state, and local regulations and procedures.

Disposal is the process of redistributing, transferring, donating, selling, abandoning, destroying, or any other disposition of the property. Disposal of components would involve establishing the availability of disposal facilities and then shipping hardware and materials to the disposal site. Disposal of materials would then conform to DoD directives, Joint Service Regulations, and comply with all applicable Federal and state laws.

Decommissioning processes will vary for weapons, sensors, C2BMC, and support assets and will be performed by the appropriate DoD agent. The following list describes the decommissioning activities that would be performed for each of the components in the proposed BMDS.

- **Weapons.** Decommisioning of weapon components would involve transferring the equipment to other uses or demilitarization in accordance with the appropriate requirements.

- **Sensors.** If sensor equipment is only needed for testing purposes and would not be used in the BMDS architecture, decommissioning would involve returning the

equipment to the responsible military service. If the equipment would be used in the BMDS architecture, decommissioning of sensors would include recycling/reuse or disposal or unused and residual materials, in accordance with the appropriate requirements. Additionally, assets can be converted to another MDA use, transferred to a military service, or sold. Space-based sensors would be decommissioned by being abandoned in orbit, parked in higher orbit, deorbited, retrieved, or reprogrammed for alternate uses.

- **C2BMC.** As technology advances and BMDS needs evolve, upgrades of C2BMC hardware and software would likely be necessary. C2BMC equipment that is replaced would be decommissioned in accordance with appropriate requirements.

- **Support Assets.** Decommissioning of equipment, infrastructure, and test assets would involve continued or adaptive use by the DoD or other government agencies, or performance of any necessary decontamination activities in the event the fixed asset will no longer be used, followed by sale. In the event of decommissioning, utilities could be left in place if the potential to use them for future DoD or other purposes existed. Mobile test or support assets would be refurbished and transferred to an alternate use, demilitarized, or dismantled and disposed. In terms of MDA BMDS Programs, aspects of particular MDA programs could be decommissioned by transferring them to another government agency, selling them, removing and using specific parts (i.e., sensors), or storing them at a government airfield. Each individual program also may have particular decommissioning activities associated with it.

Decommissioning could involve complete termination of operations and disposal of the system or its replacement with a new or upgraded system. Individual components would be removed from test ranges and test facilities at the conclusion of the testing activities. Testing facilities could also be decommissioned when they are no longer needed for the BMDS testing program.

Prior to decommissioning components, the MDA would evaluate the components for continued use by other U.S. Government agencies (e.g., U.S. Customs, U.S. Department of the Treasury) or as candidates for Foreign Military Sales. Various adaptive reuses would be analyzed and implemented if appropriate. If no adaptive reuses were identified, the units would be demilitarized and disposed as excess to the needs of the Government.

2.4 Alternatives

This PEIS considers two alternative approaches to providing the layered integrated BMDS program described in sections 2.1, 2.2, and 2.3. MDA analysis of the threat environment (potential launch locations, missile flight paths, and target locations) concludes that an effective missile defense should include weapons components based on at least the land, sea, and air. The addition of a space-based weapons platform would

provide another layer of missile defense capability. Providing only one or two weapons platforms would either leave areas unprotected or reduce the opportunities to engage threat missiles.

2.4.1 Alternative 1 – Implement Proposed BMDS with Land-, Sea-, Air-based Weapons Platforms

In Alternative 1, the MDA would develop, test, deploy, and plan to decommission land-, sea- and air-based platforms for BMDS weapons components and related architecture and assets. The BMDS envisioned in Alternative 1 would include space-based sensors, but would not include space-based weapons.

This section describes components and associated activities that would occur during each stage of the acquisition life cycle (development, testing, deployment, and decommissioning) under Alternative 1. Individual components would be developed and tested to determine the adequacy for deployment, that is, military utility and ability to function in an integrated BMDS. In addition, the BMDS C2BMC architecture would be designed and tested to meet the needs of an integrated system. Components deemed capable of integrated BMDS activities would be deployed and decommissioned as needed.

2.4.1.1 Alternative 1 - Development

Weapons subcomponents such as boosters, kill vehicles, and lasers would be derived from the existing and proposed elements. Development of the BMDS components as described in Section 2.3.1 for Alternative 1 would involve the following weapons components based on land, sea, and air operating environments

- Land – GMD GBI; THAAD; PAC-3; AWS; MEADS; KEI
- Sea – Aegis BMD; KEI
- Air – ABL

Development of BMDS sensors would build on existing sensors and infrastructure on land, sea, air and space operating environments. The development of C2BMC and support assets would be closely linked with the development of other components. The C2BMC is designed to mold components into a complementary and synergistic system-of-systems. Ongoing development of BMDS components is required to meet evolving functional capabilities. The main types of development activities include planning, budgeting, research and development, systems engineering, maintenance and sustainment, manufacture and initial testing of prototype test articles, and conduct of tabletop exercises.

New technologies are continuously being considered by the MDA's Advanced Systems program and by Systems Engineering Directorate within the MDA in concert with the National Team. The technologies and programs underway are discussed in Appendix F.

2.4.1.2 Alternative 1 - Testing

Testing activities, as discussed in Section 2.3.2, comprises the majority of activities under Alternative 1. Testing of the BMDS components and elements provides system characterization, verification, and assessment. Systems integrated tests rest on a foundation of component and element level tests, which were described in previous environmental documentation. This PEIS analyzes System Integration Tests including Modeling, Simulation and Analysis, integrated missile defense wargames, MDIEs, GTs and SIFTs. For the purposes of this analysis, all integrated tests with the exception of the SIFTs involve only ground-based components. The SIFTs could include a combination of any of the existing or planned land-, sea-, or air-based weapons components, and any land-, sea-, air- or space-based sensors and support assets. Integrated testing would determine the ability of the evolving C2BMC to integrate the BMDS components. The SIFTs will be discussed in terms of existing and reasonably foreseeable test scenarios. Existing SIFTs leverage currently scheduled element tests. Future SIFTs would be developed with increasing fidelity and complexity. SIFTs would involve the launch of at least one target missile to be negated by either an interceptor missile or a laser. Several sensor systems would acquire and track the target missile and interceptor missile (or ABL), as well as the actual intercept. For each planned test intercept, debris impact zones would be established. SIFTs could cross multiple environment types. Testing would occur within the confines of the U.S. and surrounding BOAs, as well as at some select locations abroad. As the proposed BMDS grows in capability, testing would expand to include more international sites.

2.4.1.3 Alternative 1 - Deployment

Under Alternative 1, the BMDS missile interceptors and directed energy missile defense system components, and related architecture and assets would be deployed on land-, sea- and air-based platforms. See Section 2.3.3 for a discussion of Deployment as part of the acquisition life cycle. Because the BMDS is envisioned to be an evolving system with interchangeable interoperable components, there is no final architecture defined for the system. Deployment would require fielding and sustainment of BMDS components in the U.S. and at strategic locations abroad. Components would be deployed as they are deemed capable of functioning within the BMDS. Fielding activities such as manufacturing, site preparation and construction and transport of components to deployment sites would be required. Sustainment activities include operation and maintenance of components, training, upgrades, and service life extensions where appropriate.

2.4.1.4 Alternative 1 - Planning for Decommissioning

Decommissioning would involve the planning for the final demilitarization and disposal of the BMDS components and support assets no longer needed for the BMDS or its testing program (see Section 2.3.4). Plans for decommissioning BMDS components and facilities would be incorporated into site development activities. Under Alternative 1, decommissioning of weapons would involve the removal and disposal of rocket propellant and dismantlement and disposal of residual materials such as the missile shell. Both testing as well as deployed components and facilities may be decommissioned. Thus, target missiles would undergo similar decommissioning processes.

Decommissioning of sensors would include the recycling/reuse and disposal of residual materials associated with the antennae, electronic, cooling and power units. Space-based sensors would be abandoned in orbit, parked in a higher orbit, deorbited, retrieved, or reprogrammed for alternate uses. C2BMC hardware and software would be upgraded or removed and disposed according to applicable requirements. Fixed facility support assets would be assigned new missions, returned to their owners, or transferred to new owners. Mobile support assets such as transportation vehicles, missile launchers and launch vehicles would be refurbished and transferred to an alternate use, or dismantled and disposed.

2.4.2 Alternative 2 – Implement Proposed BMDS with Land-, Sea-, Air- and Space-based Weapons Platforms

In Alternative 2, the MDA would develop, test, deploy and plan to decommission land-, sea-, air- and space-based platforms for weapons and related architecture and assets. Alternative 2 would be identical to Alternative 1, with the addition of space-based defensive weapons. A space-based test bed would be considered and evaluated to determine the feasibility of using kinetic energy to intercept threat missiles from space.

This section describes the space-based weapons components and associated acquisition life cycle activities under Alternative 2. Individual components would be tested to determine the adequacy for military utility and ability to function in an integrated BMDS. In addition, the BMDS C2BMC architecture would be designed and tested to meet the needs of an integrated system.

2.4.2.1 Alternative 2 - Development and Testing

MDA is developing an exoatmospheric kill vehicle (EKV), which, as described in Section 2.2.1, acts as the kinetic energy weapon on an interceptor. EKVs could be launched as hit-to-kill weapons from a space-based platform. Under Alternative 2, the KEI is a potential space-based defensive weapon to counter threat ballistic missiles during boost phase. The development of midcourse and terminal phase defensive

weapons may be included as well. The new interceptor would have effectiveness similar to earlier interceptors but would achieve it by decreasing the mass of the interceptor and increasing the speed at which the interceptor travels. This interceptor may use existing or new boosters; however, a new EKV would likely be designed for the interceptor. The EKV would be adaptable and could be launched from a space-based platform. Testing of a space-based weapons platform would involve ground-based testing including modeling and simulations of space-based technology, as well as multiple launches to emplace prototype technology in orbit. The prototype would then be tested in increasing realistic scenarios involving simulated and actual intercepts of targets. The Near-field Infrared Experiment (NFIRE) spacecraft could be launched on a Minotaur space launch vehicle from Wallops Flight Facility. The spacecraft bus would be shipped unfueled; however, the payload would be shipped fully fueled from the manufacturer. Spacecraft integration with the booster would also occur at Wallops Flight Facility.

2.4.2.2 Alternative 2 - Deployment

MDA would deploy EKVs and space-based launch platforms to deploy a space-based weapons component, currently envisioned as the KEI. The MDA would also obtain launch services to deploy the launch platform satellite and weapons components into their orbits. They could use Evolved Expendable Launch Vehicles launched from Vandenberg AFB and Cape Canaveral.

2.4.2.3 Alternative 2 - Planning for Decommissioning

A space-based weapons platform resembling a satellite would be decommissioned by being abandoned in orbit, parked in a higher orbit, deorbited, or retrieved. A weapons platform carrying a sensor system could have alternate uses including monitoring rocket launches and aircraft flights. MDA or the military services would make decisions on the disposition of the space-based weapons platforms based on the stability of the orbits, the costs and risks of deorbiting or retrieval, the remaining useful life of the equipment, and potential for alternate uses.

2.5 No Action Alternative

Under the No Action Alternative, the MDA would not test, develop, deploy, or plan for decommissioning activities for an integrated BMDS. Instead, the MDA would continue existing test and development of discrete missile defense systems as stand-alone defensive capabilities.

Under the No Action Alternative, individual components would continue to be tested to determine the adequacy of their stand-alone capabilities, but would not be subjected to integrated system-wide tests. In addition, the C2BMC architecture would be designed

around the needs of individual components and would not be designed or tested to meet the needs of an integrated system.

The approach and methods for deployment and decommissioning of components under the No Action Alternative would be the same as under the proposed action. However, deployment of individual components could occur earlier under the No Action Alternative because they would not undergo System Integration Testing. In addition, a greater number of units of the components may need to be deployed to provide a comparable number of opportunities to intercept threat missiles as provided by an integrated system.

Failure to deploy a fully integrated BMDS could result in the inability to respond to a ballistic missile attack on the U.S. or its deployed forces, allies and friends in a timely and successful fashion. This could result in the successful attack on one or more large population centers with chemical, biological, or nuclear weapons of mass destruction. The threat of such an attack could also jeopardize national security interests. Further, this alternative would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress.

2.6 Alternatives Considered But Not Carried Forward

2.6.1 Cancel Development of Ballistic Missile Defense Capabilities

As suggested to the MDA during the scoping process, one alternative would involve canceling the development of all ballistic missile defense capability development and testing. Such an alternative would rely upon diplomacy and military measures to deter missile threats against the U.S. However, this proposed alternative would eliminate the capability to defend the U.S., its deployed forces, allies, or assets from a ballistic missile attack should diplomacy or other deterrents fail. This alternative does not meet the purpose of or need for the proposed action as described in Sections 1.3 and 1.4, respectively; does not meet the direction of the President and the U.S. Congress; and therefore will not be analyzed further.

2.6.2 Single or Two-Platform BMDS

MDA has evaluated the threat environment (potential launch locations, missile flight paths, and target locations) and concluded that an effective missile defense should include components based on at least the land, sea, and air. Alternatives that provide only one or two platforms would reduce the capability of the BMDS to defend the U.S., its deployed forces, allies, or assets from a ballistic missile attack. This could result in the successful attack on one or more large population centers with chemical, biological, or nuclear weapons of mass destruction. The threat of such an attack could also jeopardize national security interests. Therefore, alternatives that provide a BMDS with only one or two platforms will not be carried forward for further analysis.

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3 AFFECTED ENVIRONMENT

Introduction

This Section discusses the biomes, ocean areas, and the atmosphere that comprise the Affected Environment in this PEIS, as well as the resource areas that could be impacted by the proposed action. This Section defines each resource area (Section 3.1) and discusses those resource areas within the context of a particular biome, ocean area or the atmosphere (Section 3.2).

The Affected Environment includes all land, air, water, and space environments where proposed activities are reasonably foreseeable. The Affected Environment considered in this PEIS includes specific locations in the U.S. and areas outside the U.S. As a result, applicable international treaties, foreign national laws and U.S. Federal, state, and local laws and regulations must be considered. The description of each resource area in Section 3.1 includes potentially relevant legal requirements and provides a roadmap of issues to consider for impacts assessment of a tiered document along with a determination of significance of the impacts. Appendix G contains additional information about laws and regulations that should be considered for subsequent impact analyses.

The Affected Environment for this PEIS examines global biomes[32] where development, testing, deployment, and planning for decommissioning activities for the proposed integrated BMDS may occur.

The biomes each cover a broad region, both geographically and ecologically. The distribution of global biomes is widely documented and accepted within the scientific community, and classification of biomes is based upon the characteristics of climate, geography, geology, vegetation, and wildlife.[33] Using biomes as affected environment designations captures the relevant differences between environments in a way that supports a useful analysis of impacts and allows future site-specific environmental documentation to tier from this PEIS. Note that there are no reasonably foreseeable BMDS activities occurring in Antarctica. For this reason, this continent does not appear on any of the biome maps in the PEIS.

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[32] Merriam-Webster defines biome as a major ecological community type (as tropical rain forest, grassland, or desert). (Merriam-Webster Online Dictionary, 2004)
[33] *Biogeography*, 2nd ed. James H. Brown and Mark V. Lomolino. Pages 110-111. Sinauer Associates, Inc. Publishers, 1998. (stating "[E]cologists and biogeographers have almost without exception classified terrestrial [ecosystems] on the basis of the structure or [natural features] of the vegetation.")

The Affected Environment in this PEIS is divided into nine terrestrial biomes, the BOA, and the Atmosphere as identified below.

- Arctic Tundra
- Sub-Arctic Taiga
- Deciduous Forest
- Chaparral
- Grasslands
- Desert
- Tropical
- Savanna
- Mountain
- BOA
- Atmosphere

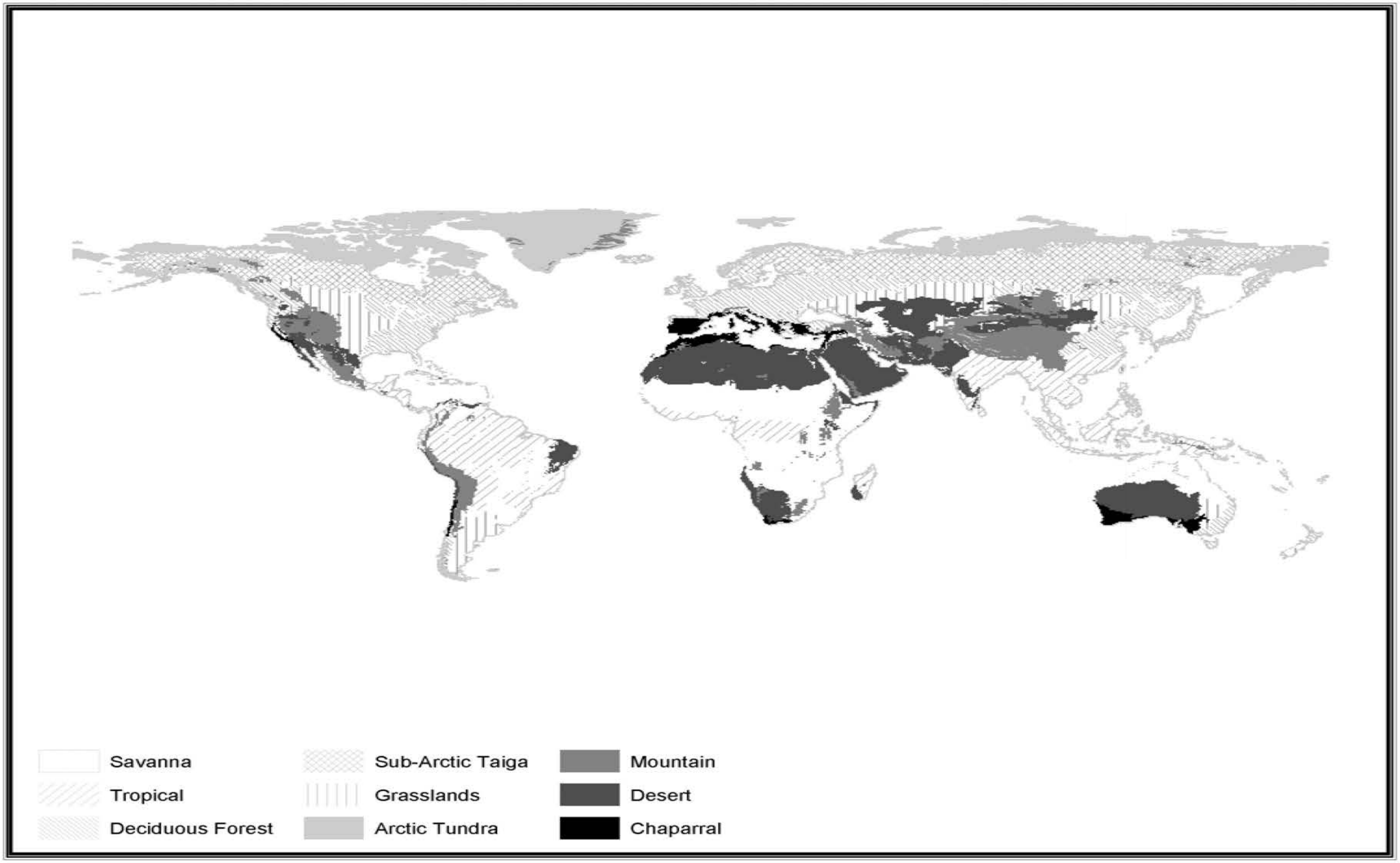
Exhibit 3-1 shows the global distribution of the various terrestrial biomes (not including the BOA and the Atmosphere). Biomes may be further subdivided based on geographic location; however, this PEIS considers nine overarching terrestrial biomes.

The characteristics (e.g., climate, geology, flora and fauna) that define a global biome are the same regardless of whether the biome area of concern is coastal or inland. However, unique features (e.g., wetlands, estuaries, wind currents, hurricanes) of coastal areas[34] may affect determination of environmental impacts. Therefore, the Affected Environment discusses these unique features within the biome descriptions. Describing coastal areas as part of the larger inland biomes minimizes repetition among the descriptions yet captures the important aspects of the coastal areas in a way suitable for impacts analysis.

Each biome description contains representative examples of past, current, or proposed locations used by the MDA within that biome. Therefore, an entity tiering from the PEIS would be able to map a particular site to its applicable biome. For example, WSMR in New Mexico is located within the Desert Biome. The description of the Desert Biome describes the particular characteristics of the biome that could affect the impacts of activities proposed at WSMR, or other locations in this biome.

[34] For the purposes of this PEIS, the coastal area includes the near shore, which is an indefinite zone extending seaward from the shoreline beyond the breaker zone, and is not coextensive with the area afforded protection under the Coastal Zone Management Act. This typically includes water depths of less than 20 meters (65 feet). The inland portion of the coastal area includes shoreline, tidal wetlands, coastal wetlands, and coastal estuaries.

Exhibit 3-1. Map of Global Biomes



Source: Modified From National Geographic, 2003b

- **Arctic Tundra Biome.** The Arctic Tundra Biome as described in Section 3.2.1 is located in areas above 60° North latitude.[35] The areas of potential interest for the BMDS in the Arctic Tundra Biome include the arctic regions of North America and the arctic coastal regions that border the North Atlantic Ocean, North Pacific Ocean, and Arctic Ocean, including portions of Alaska, Canada, and Greenland (administered by Denmark).

- **Sub-Arctic Taiga Biome.** The Sub-Arctic Taiga Biome as described in Section 3.2.2 occurs between 50° to 60° North latitudes. The areas of interest in the Sub-Arctic Taiga Biome include the sub-arctic regions of North America and the sub-arctic coastal regions that border the North Pacific Ocean, including portions of Alaska.

- **Deciduous Forest Biome.** The Deciduous Forest Biome as described in Section 3.2.3 is located in the mid-latitude, which means that it is found between the Polar Regions and the tropics. The areas of interest in the Deciduous Forest Biome include the eastern and northwestern U.S. and portions of Europe.

- **Chaparral Biome.** The Chaparral Biome as described in Section 3.2.4 occurs on the west coastal regions of continents between 30° and 40° North and South of the equator. The Chaparral Biome areas of interest include a portion of the California Coast and the coastal region of the Mediterranean from the Alps to the Sahara Desert and from the Atlantic Ocean to the Caspian Sea.

- **Grasslands Biome.** The location of the Grasslands Biome as described in Section 3.2.5 is not limited to a particular latitude range. Instead, Grasslands occur in the middle of all continents, except Antarctica. The areas of interest in the Grasslands Biome include prairie regions of the Midwestern U.S.

- **Desert Biome.** The Desert Biome as described in Section 3.2.6 is located between 15° and 35° North and South of the equator. The area of interest in the Desert Biome includes the western arid environment of the southwestern U.S.

- **Mountain Biome.** The Mountain Biome as described in Section 3.2.7 occurs in areas with high elevations just below and above the snow line of a mountain. The area of interest in the Mountain Biome includes the Rocky Mountains in the western U.S. and the Alps in central Europe.

[35]The latitudinal designations identify the general location for each biome; however, the biomes do not have rigid edges that begin and end at these latitudes. Therefore, there may be some overlap of biomes at or near these latitudinal designations.

- **Tropical Biome.** The Tropical Biome as described in Section 3.2.8 occurs between the Tropic of Cancer (23.5° North) and the Tropic of Capricorn (23.5° South). The area of interest in the Tropical Biome includes the Hawaiian Islands.

- **Savanna Biome.** The Savanna Biome as described in Section 3.2.9 occupies latitudes between 5º and 20º North and South of the equator. The area of interest in the Savanna Biome includes northern Australia.

- **Broad Ocean Area (BOA) Environment.** For the purposes of this PEIS, the BOA Environment as described in Section 3.2.10 includes the Pacific Ocean, the Atlantic Ocean, and the Indian Ocean.

- **Atmosphere Environment.** The Atmosphere Environment as described in Section 3.2.11 includes the atmosphere that envelops all areas of the Earth and consists of four principal layers: troposphere, stratosphere, mesosphere, and ionosphere (or thermosphere).

The description of the Affected Environment must be specific enough to allow meaningful assessment of potential impacts, yet broad enough to encompass all potential locations. The information in this Section and analysis in Section 4 do not purport to address site-specific issues. Additional analyses may be required to determine site-specific impacts for a proposed action.

The Affected Environment is discussed in terms of the following resource areas: air quality; airspace; biological resources; cultural resources; environmental justice; geology and soils; hazardous materials and hazardous waste; health and safety; land use; noise; socioeconomics; transportation; utilities; visual resources; and water resources. These areas represent the resources that the proposed BMDS may impact and were identified based on review of previous environmental documentation for the MDA, the DoD, and other agencies that conduct activities similar to those proposed for the BMDS (e.g., U.S. Air Force, NASA, FAA).

Definitions and descriptions are provided below for each resource area followed by a discussion of the issues that an impact assessment should address. Some resource areas are not analyzed in Section 4 of this PEIS, because they depend upon local factors and conditions and are too dependent on local information requirements to discuss meaningfully at a programmatic level. These resource areas include: cultural resources, environmental justice, land use, socioeconomics, utilities, and aesthetics (visual resources).

3.1 Resource Areas

3.1.1 Air Quality

Definition and Description

Air quality is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, the prevailing meteorological conditions, and the location of sensitive receptors relative to the source of the emission of air pollutants. Air pollutants of concern fall into four categories.

- **Criteria Air Pollutants**. These are a group of seven pollutants identified in the Clean Air Act for which the U.S. EPA is required to establish allowable concentrations in ambient air: sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (including the compounds that contribute to its formation - volatile organic compounds [VOCs] and nitrogen oxides [NO_X]), particulate matter (PM) with a diameter of less than ten microns (PM_{10}), particulate matter of with a diameter of 2.5 microns or less ($PM_{2.5}$), and lead.

- **Hazardous Air Pollutants (HAPs)**. These are a group of 188 chemicals identified in the 1990 Clean Air Act Amendments (40 U.S.C. 7412(b)). Exposure to these pollutants has been determined to cause or contribute to cancer, birth defects, genetic damage, and other adverse health effects. Examples of HAPs include benzene, asbestos, and carbon tetrachloride.

- **Mobile Source Air Toxics**. These are a group of 20 HAPs plus "diesel PM and diesel exhaust organic gases," which are complex mixtures that contain numerous HAPs.

- **Regional Haze Pollutants**. The principle air pollutants that cause regional haze are SO_2, NO_X, VOC, PM_{10}, $PM_{2.5}$, and ammonia. The fraction of PM in the $PM_{2.5}$ size range is the most active component of PM in visibility degradation. SO_2, NO_X, VOC, and ammonia all undergo chemical transformations that result in the formation of sulfate, nitrate, and organic aerosols in the fine size range.

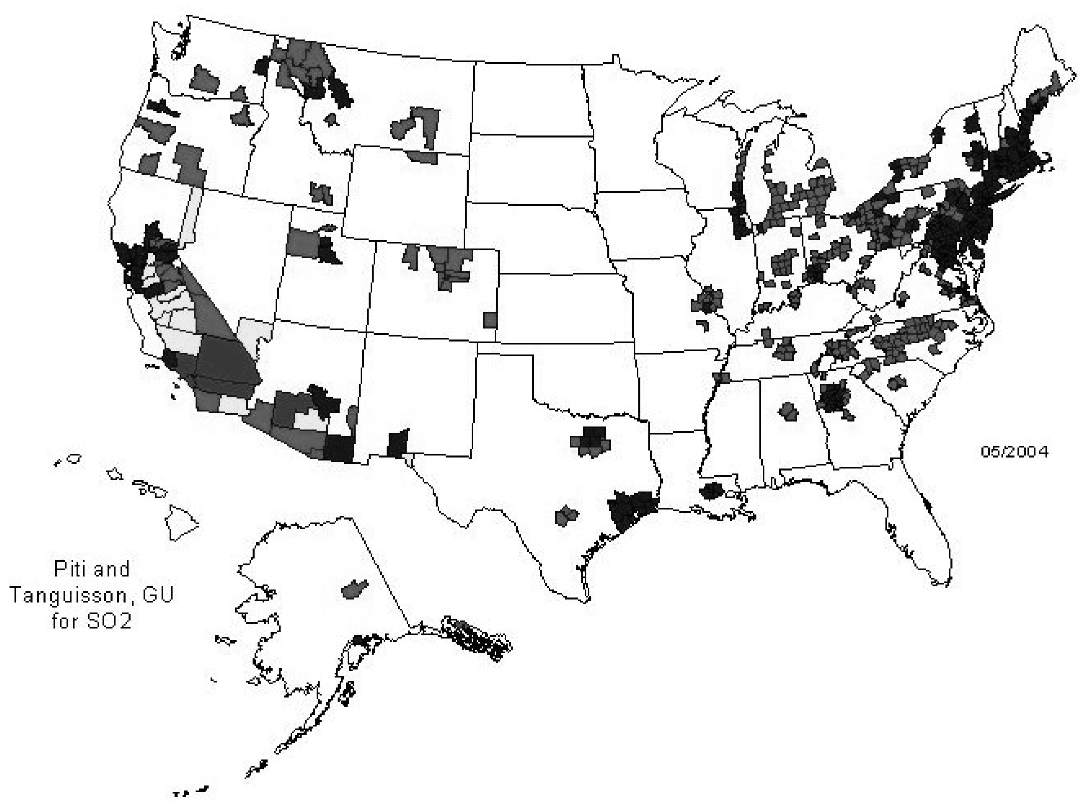
Sources of air pollutants include stationary sources (e.g., industrial facilities, refineries, power plants, launch pads), area sources (which are a collective representation of sources not specifically identified), mobile sources (e.g., motor vehicles, ships, aircraft, off-road engines, mobile platforms), and biogenic (natural) sources (e.g., forest fires, volcanoes).

The size and topography of the air basin, as well as the prevailing meteorological conditions determine how air pollutants are dispersed. Air currents carry secondary

pollution from one region to another, often increasing the background levels of air pollutants for the recipient regions. Such conditions are addressed in the Clean Air Act Section 184, which defines an Ozone Transport Region that includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Washington D.C. The emission standards are more protective in Ozone Transport Regions. An example of secondary pollution would be ozone (smog) created when NO_X and VOCs react in the presence of sunlight. The NO_X and VOCs could be released into the atmosphere a long distance from where the ozone ultimately degrades the air quality.

The Clean Air Act (42 U.S.C. 7401) requires the adoption of National Ambient Air Quality Standards (NAAQS) to protect the public health, safety, and welfare from known or anticipated effects of criteria air pollutants. According to EPA guidelines, an area with air quality better than the NAAQS is designated as being in attainment, while areas with worse air quality are classified as non-attainment areas. Pollutants in an area may be designated as unclassified when there are insufficient data for the EPA to identify attainment status. Current non-attainment areas in the U.S. are indicated in Exhibit 3-2.

Exhibit 3-2. Non-Attainment Areas for Criteria Pollutants January 2004



Note: Map is shaded by county to indicate the number of criteria pollutants for which the county is in non-attainment. However, the purpose of this exhibit is to generally illustrate the location of non-attainment areas in the U.S.

Source: EPA, 2004

The official list of non-attainment areas and a description of their boundaries can be found in the CFR at 40 CFR Part 81 and pertinent FR notices. EPA maintains an unofficial list on the Internet at http://www.epa.gov/oar/oaqps/greenbk/. As of February 2004, there were 68 non-attainment and 69 maintenance areas for ozone, 59 nonattainment and 24 maintenance areas for PM_{10}, 11 nonattainment and 65 maintenance areas for CO, 22 nonattainment and 30 maintenance areas for SO_2, and eight maintenance areas for lead.

For areas that are designated non-attainment, the Clean Air Act establishes levels and timetables for each region to achieve attainment of the NAAQS. States must prepare a State Implementation Plan (SIP), which documents how the region will reach its attainment levels by the required date. The SIP includes inventories of emissions within the area and establishes emissions budgets that are designed to bring the area into compliance with the NAAQS. In maintenance areas, the SIP documents how the state intends to maintain compliance with NAAQS.

Section 176(c) of the Clean Air Act prohibits Federal entities from taking actions in non-attainment or maintenance areas that do not "conform" to the SIP. The purpose of the conformity regulation is to ensure that Federal activities 1) do not interfere with the budgets in the SIPs; 2) do not cause or contribute to new violations of the NAAQS; and 3) do not impede the ability to attain or maintain the NAAQS. In November 1993, EPA promulgated two sets of regulations to implement CAA section 176(c):

- The Transportation Conformity Regulations, which establish the criteria and procedures for determining that transportation plans, programs, and projects funded under Title 23 U.S.C. or the Federal Transit Act conform to the SIP. The transportation conformity regulations are codified in 40 CFR 93, in Subpart A.

- The General Conformity Regulations, which ensure that other Federal actions also conform to the SIPs, and are applicable to all other Federal actions not covered under Transportation Conformity. The General Conformity regulations are codified in 40 CFR 93, Subpart B. All Federal actions are covered unless otherwise exempt (such as actions covered by transportation conformity, exempt actions listed in the rule, and cases where the action does not create emissions above the *de minimis* threshold levels specified by EPA regulations in 40 CFR 93.153(b)).

The proposed action is subject to the General Conformity Regulations, not Transportation Conformity Regulations. Under the General Conformity Regulations, MDA is required to determine whether the proposed action and alternatives would result in emissions within a non-attainment or maintenance area that would exceed established *de minimis* levels or would be regionally significant (i.e., exceed ten percent of the emission inventory). If so, MDA must make a General Conformity Determination in accordance

with EPA requirements. Exhibit 3-3 shows *de minimis* levels of pollutants for various non-attainment levels.

Exhibit 3-3. General Conformity *De Minimis* Levels

Criteria Pollutant	Area Designation	Pollutant	*De Minimis* Level, metric tons per year (tons per year)
Ozone	Extreme Non-attainment	NO_X or VOC	9 (10)
	Severe Non-attainment	NO_X or VOC	23 (25)
	Serious Non-attainment	NO_X or VOC	45 (50)
	Other Non-attainment with Transport	NO_X	91 (100)
	Other Non-attainment with Transport	VOC	45 (50)
	Other Non-attainment without Transport	NO_X or VOC	91 (100)
	Maintenance	NO_X	91 (100)
	Maintenance with Transport	VOC	45 (50)
	Maintenance without Transport	VOC	91 (100)
PM_{10}	Serious Non-attainment	PM_{10}	64 (70)
	Moderate Non-attainment	PM_{10}	91 (100)
	Maintenance	PM_{10}	91 (100)
CO	Non-attainment or Maintenance	CO	91 (100)
SO_2	Non-attainment or Maintenance	SO_2	91 (100)
NO_2	Non-attainment or Maintenance	NO_2	91 (100)
Lead	Non-attainment or Maintenance	Lead	23 (25)

Source: 40 CFR 93.153(b)

The Clean Air Act lists 188 HAPs, which are individual chemicals or elements that have been linked to observed human health effects such as increased risk of cancer, damage to the immune system, neurological problems, damage to reproductive systems (e.g., reduced fertility) and developmental systems, respiratory damage, and other health problems. Details on precisely how each HAP affects humans can be found in EPA's Integrated Risk Information System, a database available to the public.[36] The elemental

[36] EPA, 2003c

HAPs are primarily metals and families of metallic compounds (e.g., mercury compounds, arsenic compounds). The remaining HAPs are primarily organic compounds and selected inorganic gaseous compounds. Benzene, ethyl chloride, and pentachlorophenol are examples of organic HAPs. Hydrochloric acid and hydrogen fluoride are examples of inorganic HAPs.

The Clean Air Act regulations include a regional haze rule (64 FR 35714 [July 1, 1999]) that requires states to develop SIPs to address visibility at designated mandatory Class I areas, including 156 designated national parks, wilderness areas, and wildlife refuges. General features of the regional haze rule are that all states are required to prepare an emissions inventory of all haze related pollutants from all sources in all constituent counties. Most states will develop their regional haze SIPs in conjunction with their $PM_{2.5}$ SIPs over the next several years.

Another concern with respect to air quality is greenhouse gas emissions. The primary greenhouse gas emitted by anthropogenic or human-derived activities in the U.S. is CO_2, which represented approximately 84 percent of total greenhouse gas emissions in 2001. The largest source of CO_2, and of overall greenhouse gas emissions, is fossil fuel combustion, both from stationary (power plants, industry and manufacturing processes) and mobile sources (automobiles, trucks, construction equipment, lawn mowers). Electric power generation, from utilities and non-utilities combined, accounted for the largest source of U.S. greenhouse gas emissions in 2001, closely followed by transportation sources and industrial processes. On an annual basis, the overall consumption of fossil fuels in the U.S., and therefore emissions from the combustion of those fuels, generally fluctuates in response to changes in general economic conditions, energy prices, weather (temperature extremes during winters and summers), and the availability/acceptance of non-fossil fuel alternatives.

Although CO, NO_X, VOCs, and SO_2 do not have a direct global warming effect, they are regulated because of their role in influencing the formation and destruction of tropospheric (ground-level) and stratospheric (upper atmosphere) ozone. CO is produced when carbon-containing fuels are combusted incompletely. NO_X (i.e., nitrogen oxide [NO] and NO_2) originate predominantly from fossil fuel combustion, with the majority of emissions from mobile sources, but also from stationary sources. VOCs, which include hundreds of organic compounds that participate in atmospheric chemical reactions, are emitted primarily from transportation, industrial processes, and non-industrial consumption of organic solvents. In the U.S., SO_2 is primarily emitted from coal combustion for electric power generation and from the metals industry. (EPA, 2003b)

Impact Assessment

MDA activities that would contribute to air quality impacts include actions that emit criteria pollutants, HAPs, mobile source air toxics, or regional haze pollutants, as well as

compounds that would affect climate change. MDA actions that would result in the emission of such pollutants and compounds include missile launches, operation of internal combustion and jet engines, incineration, heating and cooling of facilities and components, use of fuel storage tanks, fueling activities, and construction. Best available control technologies are applied to new emissions sources and to sources that are modified to minimize the effects that MDA activities would have on air quality. Impacts on the regulated local and regional air quality from activities related to the proposed BMDS would result from construction and operation activities at specific locations, launch related activities, and other general activities. The emission of CO_2 and ozone-depleting substances associated with the proposed BMDS has the potential to result in climate change impacts.

Construction and Operations Activities

Emissions resulting from site preparation and construction activities as well as new or increased operations activities would include PM, CO, NO_X, sulfur oxides (SO_X), and VOC. The use of construction and supply equipment may increase all types of emissions. Emissions due to new or increased site operations activities would result from

- Increase in overland shipments related to new or increased operations;
- Use of new equipment and generators or increased use of existing equipment and generators;
- Relocation of support personnel and localized increase in commuter traffic;
- Use of new fuel storage facilities or the increased use of existing fuel storage facilities;
- Use of new facilities and associated infrastructure (boilers, solvent degreasing, painting, used oil, spills, and incineration) or the increased use of existing facilities and associated infrastructure; and
- Use of earth-moving equipment during construction.

Emissions should be determined using EPA emissions factors and compared against ambient air quality standards. The emissions associated with industrial operations would be compared against historically similar operations or by methods outlined in the toxics release inventory, as necessary.

Launch Emissions

Emissions resulting from launch related activities would include CO, NO_X, PM, SO_X, VOC, and hydrogen chloride (HCl). The analysis of launch emissions impacts can be considered in two categories, above and below 914 meters (3,000 feet). The 914-meter (3,000-foot) altitude is an appropriate threshold because the EPA uses this altitude for determining contributions of emissions to ambient local and regional air quality. EPA emissions factors should be used to determine emissions fractions for each emission

source for emissions above and below 914 meters (3,000 feet). Total emissions should be estimated by multiplying emissions fractions by the total amount of propellant used.

Determination of Significance

For actions that would occur in the U.S. within a non-attainment or maintenance area, the total annual emission of each criteria pollutant would be calculated and would be compared against EPA *de minimis* levels. Annual emissions values that exceed the *de minimis* level or ten percent of the total emission budget of the non-attainment or maintenance area, or state or local ambient air quality standards would be considered significant and would require a general conformity evaluation.

The risk associated with the emissions of HAPs on sensitive receptors within the U.S. would be evaluated. (EPA, 1999) Risk factors that exceed acceptable levels established by EPA would be considered significant. Emissions within the U.S. would also be compared against the requirements and standards included in SIPs to address visibility at Class 1 areas (156 designated national parks, wilderness areas, and wildlife refuges). Emissions that exceed the regional haze standard of an SIP would be considered a significant impact. Actions proposed to occur outside of the U.S. and its territories would be reviewed in accordance with applicable international or foreign ambient air quality standards. Emissions that would occur in locations that violate applicable international or foreign laws would be considered significant.

The effects of emissions that would occur above an altitude of 914 meters (3,000 feet) would be reviewed for potential contribution to ozone depletion (particularly in the upper troposphere/stratosphere), acid rain, and global warming. To determine the significance of impacts to air quality, emission levels would be compared with studies of other similar emissions, as well as U.S. or global emissions of ozone-depleting substances, acids and greenhouse gases (e.g., CO_2). Annual emissions greater than one percent of the global emissions, annual MDA program emissions that exceed the average level of emissions associated with the program over the preceding three years by more than ten percent or single events that exceed one percent of the global emissions would be considered significant.

3.1.2 Airspace

Definition and Description

Airspace refers to the space that lies above a nation and comes under its jurisdiction. Airspace is a finite resource that can be defined vertically and horizontally, as well as temporally. Time is an important factor in airspace management and air traffic control. The FAA has established various airspace designations to protect aircraft while operating near and between airports and while operating in airspace identified for defense-related

purposes. Flight rules and air traffic control procedures govern safe operations in each type of designated airspace. Military operations follow specific procedures to maximize flight safety for both military and civil aircraft.

The types of airspace are defined by the complexity or density of aircraft movements, the nature of operations conducted within the airspace, the level of safety required, and the national and public interest in the airspace. The classes of airspace are controlled, uncontrolled, special use, and other airspace, as defined in Exhibit 3-4.

Exhibit 3-4. Definitions of Airspace Categories

Category	Definition	Examples
Controlled Airspace	Airspace used by aircraft operating under Instrument Flight Rules (IFR) that require different levels of air traffic service	Altitudes above Flight Level (FL) 180 (5,500 meters [18,000 feet] above MSL) Airport Traffic Areas Airport Terminal Control Areas Jet Routes Victor Routes
Uncontrolled Airspace	Airspace primarily used by general aviation aircraft operating under Visual Flight Rules (VFR)	As high as 4,420 meters (14,500 feet) above MSL
Special Use Airspace	Airspace within which specific activities must be confined or access limitations are placed on non-participating aircraft	Restricted Areas Military Operating Areas (MOA)
Other Airspace	Airspace not included under controlled, uncontrolled, or special use categories	Military Training Routes

Controlled Airspace

Controlled Airspace covers airspace used by aircraft operating under IFR that require different levels of air traffic service. As shown in Exhibit 3-4, examples of controlled airspace include the altitudes above FL 180 (approximately 5,500 meters (18,000 feet) above MSL, some Airport Traffic Areas, and Airport Terminal Control Areas. General controlled airspace includes the established Federal airways system, which consists of the high altitude (Jet Routes) system flown above FL 180, and the low altitude structure (Victor Routes) flown below FL 180.

Controlled airspace has numerous designations from Class A to Class G depending upon the degree of airspace control required to maintain flight safety. Airspace in North America contains "North American Coastal Routes," which are numerically coded routes

preplanned over existing airways and route systems to and from specific coastal fixes. North American Routes consist of

- **Common Route/Portion.** That segment of a North American Route between the inland navigation facility and the coastal fix.

- **Noncommon Route/Portion.** That segment of a North American Route between the inland navigation facility and a designated North American terminal.

- **Inland Navigation Facility.** A navigation aid on a North American Route at which the common route and/or the noncommon route begins or ends.

- **Coastal Fix.** A navigation aid or intersection where an aircraft transitions between the domestic route structure and the oceanic route structure.

During peak air travel times in the U.S., there are about 5,000 airplanes in the sky every hour. This translates to approximately 50,000 aircraft operating in U.S. skies each day. The U.S. airspace is divided into 21 zones (centers), and each zone is divided into sectors. Also within each zone are portions of airspace, about 81 kilometers (50 miles) in diameter, called Terminal Radar Approach Control airspaces. Multiple airports exist within each of these airspaces and each airport has its own airspace with an eight-kilometer (five-mile) radius.

Uncontrolled Airspace

Uncontrolled Airspace is primarily used by general aviation aircraft operating under VFR and generally refers to airspace not otherwise designated and operations below 365.8 meters (1,200 feet) above ground level. Uncontrolled airspace is not subject to the strict conditions of flight required by those aircraft using controlled airspace and can extend as high as 4,420 meters (14,500 feet) above MSL.

Special Use Airspace

Special Use Airspace is airspace within which specific activities must be confined or for other reasons, access limitations are imposed upon non-participating aircraft. The types of Special Use Airspace are

- **Alert Areas.** Alert areas are airspace in which a high volume of pilot training activities or unusual aerial activity takes place. The activities within alert areas are not considered hazardous to aircraft and are conducted in accordance with FAA regulations. Both participating and transiting aircraft are responsible for collision avoidance. (FAA, 2003)

- **Restricted Areas.** Restricted areas contain airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Activities within these areas are confined to permitted activities and limitations are imposed upon all other aircraft operations. Restricted areas generally are used to contain hazardous military activities. The term “hazardous” implies, but is not limited to, weapons deployment (these areas also are referred to as controlled firing areas and may be either live or inert), aircraft testing, and other activities that would be inconsistent or dangerous with the presence of non-participating aircraft.

- **MOAs.** MOAs include airspace designated for non-hazardous military activities and are established outside of controlled airspace below FL180. Typical activities that occur in MOAs include military pilot training, aerobatics, and combat tactics training. When MOAs are in use, non-participating aircraft flying under IFR clearances are directed by air traffic control to avoid the MOA. However, even when a MOA is in use, entry into the area by VFR aircraft is not prohibited, and flight by non-participating aircraft can occur on a see-and-avoid basis.

- **Prohibited Areas.** Prohibited areas include airspace where no aircraft may be operated without the permission of the using agency. This airspace is established for security and other national welfare reasons. (FAA, 2003)

- **Warning Areas.** Warning areas include airspace that may contain hazards to non-participating aircraft in international airspace. Warning areas are established beyond the 22.2-kilometer (12-nautical-mile) limit. Although the activities conducted within warning areas may be as hazardous as those in restricted areas, warning areas cannot be legally designated as restricted areas because they are over international waters. (FAA, 1996) By Presidential Proclamation No. 5928, December 27, 1988 (issued in 1989), the U.S. territorial limit was extended from 5.6 to 22.2 kilometers (three to 12 nautical miles). Special Federal Aviation Regulation 53 establishes certain regulatory warning areas within the new (5.6- to 22.2-kilometer [three to 12-nautical-mile]) territorial airspace to allow continuation of military activities while further regulatory requirements are determined.

Other Airspace

Other Airspace includes Military Training Routes. They are low altitude, high-speed routes established by the FAA as airspace for special use by the military services. Routes may be established as IFR Routes or VFR Routes. Military Training Routes are depicted on aeronautical charts and detailed descriptions are provided in the DoD Flight Information Publication AP/1B.

En route airways and jet routes are air corridors used by commercial and private aircraft. These corridors are generated based on the prevailing jet stream and their positions vary. The airways are identified by a "V" and a number designation and apply to altitudes up to 5.5 kilometers (18,000 feet). Jet routes are identified by a "J" and a number designation and apply to altitudes over 5.5 kilometers (18,000 feet). Coordination procedures used at locations where activities for the proposed BMDS may occur would prevent any potential impacts to aircraft in these routes.

Impact Assessment

Assessment of potential impacts on airspace would include a review and analysis of

- Projected volume and frequency of flights into airspace areas;
- Operating altitudes of vehicles, missiles, and targets;
- Lateral orientation of aircraft, missiles, and targets;
- Identification of airspaces that would be entered;
- Anticipated effect of the use of sensors on airspace availability;
- Effects of intercept or booster failure debris on airspace areas;
- Identification and description of the Region of Influence;
- Necessary approvals or agreements with controlling and using agencies for special use airspaces; and
- Comparison of airspace used by aircraft operating under IFR versus VFR.

Using this information, a map of the Region of Influence would be developed for the affected areas, as well as charts detailing the airspace areas and potential conflicts or approval hurdles. Specific activities may require letters of agreement to operate in certain airspace. Impacts on airspace due to activities associated with the proposed BMDS would be identified at the programmatic level and mitigated to the extent possible. Site-specific impacts on airspace would be addressed in site-specific documentation.

Determination of Significance

Actions that conflict with existing airspace use or designations where approvals or agreements with regulatory agencies cannot be obtained would be considered significant.

3.1.3 Biological Resources

Definition and Description

Native or naturalized vegetation (flora), wildlife (fauna), and the habitats they occupy are collectively referred to as biological resources. As part of the NEPA analysis, the potential impacts to all species potentially impacted by the proposed activity are

considered and evaluated. Special emphasis is placed on those species that are designated as sensitive. Plant and wildlife species may be designated as sensitive because of overall rarity, endangerment, unique habitat requirements, and restricted distribution. Generally, a combination of these factors leads to a sensitivity designation. Sensitive plant and wildlife species include those listed or proposed to be listed as threatened or endangered by the USFWS and National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries Service) under the Endangered Species Act, as well as those species listed by state wildlife resource agencies.

Federally or state listed species are afforded regulatory protection that involves a permitting process, including specific mitigation measures for any allowable (incidental) impacts to the species. Species proposed to be listed are treated similarly to listed species, but recommendations of the USFWS are advisory rather than mandatory in the case of proposed species. A federally listed endangered species is defined as any species, including subspecies that is in "in danger of extinction throughout all or a significant portion of its range." A federally listed threatened species is defined as any species "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Proposed threatened or endangered species are those species for which a proposed regulation has been published in the FR, but a final rule has not been issued. In addition, the USFWS may designate critical habitat for threatened or endangered species. Critical habitat is defined as specific areas, within the geographical areas occupied by the species at the time it is listed, which contain the physical or biological features essential to conservation of the species and may require special management considerations or protection. In 2003, Congress amended the Endangered Species Act to allow the Secretary of the Interior to exempt DoD sites from critical habitat designations if adequate natural resources management plans are in place at the sites.

Federal agencies that propose to conduct activities that may impact a listed species or a species proposed to be listed are required to consult with the USFWS under Section 7 of the Endangered Species Act. Additional consultation activities with USFWS and other agencies with natural resource management responsibilities may be required under other applicable laws and regulations. A listing of relevant laws, regulations, and EOs is provided in Appendix G.

Impact Assessment

The impact analysis should include existing information on plant and animal species and habitat types in the vicinity of proposed sites, with special emphasis on the presence of any species listed as threatened or endangered by Federal or state agencies. In the U.S., proposed activities must be coordinated with the appropriate state wildlife agency to determine if threatened and endangered species or critical habitat exists within the region

of influence. If the proponent of the proposed activity determines that threatened or endangered species or critical habitat may be affected by the proposed action, the proponent would initiate either informal consultation or formal consultation under Section 7 of the Endangered Species Act. The consultation process may require the proponent of the proposed activity to conduct a biological assessment, resulting in a biological opinion from the resource agency. This opinion would include mitigation actions required of the proponent to ensure that impacts to species and habitat would be minimized.

If the proponent of the proposed action determines that marine mammals may be affected by the proposed action, the proponent should consult with NOAA Fisheries Service, Department of Interior, U. S. Fish and Wildlife Service, as appropriate, to ensure compliance with the Marine Mammal Protection Act. The Marine Mammal Protection Act established a moratorium, with certain exceptions, on the taking of marine mammals in U.S. waters and by U.S. citizens on the high seas, and on the importing of marine mammals and marine mammal products into the U.S. If the proponent of the proposed action determines that coral reefs or endangered fish habitat may be affected by the proposed action, the proponent should work with NOAA Fisheries Service to ensure all requirements are met.

If the proponent of the proposed activity determines that migratory bird species may be adversely impacted, then the proponent should consult with the USFWS's Regional Migratory Bird Program, to ensure compliance with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. Under the Migratory Bird Treaty Act, the taking of migratory birds is not authorized without a permit. The project proponent should also consult with the USFWS to determine whether conservation measures may be implemented to minimize or avoid the take of migratory birds. MDA has included a technical appendix, Appendix N, considering the potential effects of radar on migratory birds.

MDA activities that could contribute to biological impacts include air emissions and noise from missiles, EMR or radio frequencies from sensors or support assets, habitat destruction through clearing activities, and construction and operations, as well as debris impacts.

Activities Resulting in Air Emissions

Air emissions from transportation vehicles, dust from clearing or construction, or launch emissions such as the ground cloud from lift-off could impact biological resources. The potential for launch emissions to impact local wildlife, vegetation, and specialized habitat, such as wetlands, should be considered.

Activities Resulting in Noise

Noise produced from missile launches and other activities related to the BMDS could affect biological resources. The potential for this noise to affect areas used by wildlife for migration, foraging, and breeding, should be considered.

Activities Resulting in EMR or Radio Frequencies

Radars and other equipment could emit EMR or radio frequencies, with the potential to impact biological resources. The analysis of EMR and radio frequency emissions should include the following metrics for review of Institute of Electrical and Electronics Engineers (IEEE) and American National Standards Institute (ANSI) standards for exposure to EM fields

- Peak and average power (modulation properties),
- Polarization of the EM field,
- Power density values for the beams over the range and azimuth of the sensor,
- Typical motion of the beams, and
- Size of the main and side beams.

Construction and Operation Activities

The impacts analysis should address construction activities and operations that could result in impacts to habitat including loss and restriction of habitat; light pollution; and leaks, spills, and other releases of contaminants. Noise impacts from operation of generators and construction equipment have the potential to impact species in the area. Other noise including sonic booms from launch and flight of missiles also should be analyzed for potential impacts on biological resources.

Debris Related Activities

Debris from booster failures or missile intercepts could impact biological resources. Debris would fall in pre-established impact zones on land or in water. The expected casualty to humans from debris produced during launches would be less than or equal to 30×10^{-6}. Debris recovery efforts, if required, would only occur on land and could result in impacts to biological resources from transportation activities. Such disturbances could include noise, emissions, fire caused by debris or unspent fuel, chemical payloads (such as tributyl phosphate), and surface disturbance impacts.

Determination of Significance

Actions that negatively affect a species or its habitat (critical habitat or essential fish habitat) protected under Federal or state law or an international treaty (e.g., Endangered

Species Act, Marine Mammal Protection Act, Magnuson-Stevens Fishery Conservation and Management Act), as well as other resources provided protection under Federal or state regulations or orders (e.g., Sikes Act, Migratory Bird Treaty Act, EO 13112 Invasive Species), where appropriate consultation or considerations have not been completed, documented, and implemented would be considered significant. In addition, it may be appropriate to consider multiple species habitat conservation planning efforts occurring in areas proximate to proposed BMDS activities.

3.1.4 Cultural Resources

Definition and Description

Cultural resources include prehistoric and historic artifacts, archaeological sites (including underwater sites), historic buildings and structures, and traditional resources (such as Native American and Native Hawaiian religious sites). Paleontological resources are fossil remains of prehistoric plant and animal species and may include bones, shells, leaves, and pollen.

Cultural resources of particular concern include properties listed or eligible for inclusion in the National Register of Historic Places (National Register). Only those cultural resources determined to be potentially significant under 36 CFR 60.4 are subject to protection from adverse impacts resulting from an undertaking. To be considered significant, cultural resources must meet one or more of the criteria established by the National Park Service that would make that resource eligible for inclusion in the National Register. The term "eligible for inclusion in the National Register" includes all properties that meet the National Register listing criteria which are specified in Department of Interior regulations at 36 CFR 60.4. Therefore, sites not yet evaluated may be considered potentially eligible for the National Register and, as such, are afforded the same regulatory consideration as nominated properties. Whether prehistoric, historic, or traditional, significant cultural resources are referred to as historic properties.

Impact Assessment

Because they possess unique qualities and characteristics, cultural and historic resources should be identified and analyzed in site-specific environmental documentation. The analysis should include consideration of the contemporary use of historic properties owned by the Federal government and intergovernmental cooperation and partnerships for the preservation and use of historic properties as required by EO 13287, Preserving America. MDA activities that could impact cultural resources primarily include construction, operation, and debris impacts.

Construction and Operation Activities

The analysis should address construction and operation activities that could result in ground disturbances, vibrations, significant air emissions, or leaks, spills, and other accidental releases of contaminants. The proponent should identify the region of influence for the activities and contact the appropriate State Historic Preservation Officer to determine whether there are any known listed or eligible sites in the vicinity and to determine whether mitigation measures are required, such as: site-specific cultural and historic surveys, records searches of the sacred lands of the Native American Heritage Commission to determine the presence of Native American cultural resources in the region of influence, contacting Native American individuals and organizations for additional information, and using a qualified archaeologist to monitor site-specific ground-disturbing activities during construction. If appropriate, construction-related personnel would be informed of the sensitivity of cultural resources and the penalties that could be incurred if sites are damaged or destroyed. If during construction, cultural items are discovered, activities should cease in the immediate area and the corresponding State or Tribal Historic Preservation Officer would be notified. Subsequent actions should follow the guidance provided.

Debris Related Activities

Debris resulting from booster failures and missile intercepts could impact cultural resources. However, prior to establishing debris impact zones, archeological, cultural and historic surveys would be conducted to determine the presence of such resources. Debris recovery efforts, if required, would only occur on land, but should not impact cultural resources outside the impact zone. Efforts would be made to mitigate any impacts of transportation, noise, emissions and surface disturbance during recovery efforts.

Determination of Significance

Actions that would destroy or alter the character of a historic property on, or eligible for inclusion on the National Register, or actions that would adversely affect a Native American or traditional cultural property, where appropriate consultation in accordance with the National Historic Preservation Act has not been completed, would be considered significant. Such consultations and mitigation measures must be approved by the appropriate State Historic Preservation Officer, Tribal Historic Preservation Officer, or the ACHP.

3.1.5 Environmental Justice

Definition and Description

Environmental Justice (EO 12898) is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the exclusion of Federal, state, local, and tribal programs and policies. Meaningful involvement means that potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that would affect their environment or health; the public's contribution can influence the regulatory agency's decision; the concerns of all participants involved would be considered in the decision-making process; and the decision-makers would seek out and facilitate the involvement of those potentially affected.

Environmental Justice concerns include consideration of the race, ethnicity, and the poverty status of populations near the site of a proposed action. The CEQ defined "minority" to consist of the following groups: Black/African American, Asian, Native Hawaiian or Other Pacific Islander, American Indian or Alaska Native, and Hispanic populations (regardless of race). The Interagency Federal Working Group on Environmental Justice guidance states that a "minority population" may be present in an area if the minority population percentage in the area of interest is "meaningfully greater" than the minority population in the general population. The CEQ defined "low-income populations" as those identified with the annual statistical poverty thresholds from the Bureau of the Census. The accepted rationale in determining what constitutes a low-income population is similar to minority populations, in that when the low-income population percentage within the area of interest is "meaningfully greater" than the low-income population in the general population, the community in question is considered to be low-income.

Impact Assessment

Although each community is unique, there are several determination procedures that are common to most environmental justice assessments. One must first identify whether the geographic area under consideration qualifies as low-income or minority-based. To identify minorities or low-income populations, the Environmental Index methodology in EPA Region 6, Office of Planning and Coordination, dated 1996 would be used. Based on that guidance, environmental justice populations can be defined as meeting either of the following criteria

- Over one-half of the residents are minorities; or
- Over one-half of the households are low income.

An analysis of the most recent census data for the area provides this information. The U.S. Census Bureau maintains census data for racial classifications and income levels. The five racial classifications for which data are maintained are white, black, Hispanic, American Indian/Eskimo/Aleut, and Asian/Pacific Islander. Low-income data relates to those households that fall below the mean poverty level. Using these data, the percentages of minority and low-income populations may be determined for a particular geographic area.

After determining whether a minority or low-income population exists in the area, a determination must be made as to whether the proposed action would have a disproportionately high or adverse effect on those populations. The analysis involves first determining whether there are significant and adverse impacts and second whether those impacts disproportionately affect the minority or low-income population in the area. Where environmental justice concerns are found, the EPA recommends increased public involvement, perhaps as early as project scoping. Public participation and access to information are emphasized in EO 12898 and the Presidential Memorandum. The Presidential Memorandum instructs agencies to provide opportunities for community input throughout the NEPA process, including identifying potential effects and mitigation measures in consultation with the community and improving access to meetings, documents, and notices.

Environmental justice analyses require information about local communities, and therefore will be analyzed in site-specific environmental documentation.

Determination of Significance

Adverse environmental impacts that disproportionately affect minority or low-income populations would be considered significant.

3.1.6 Geology and Soils

Definition and Description

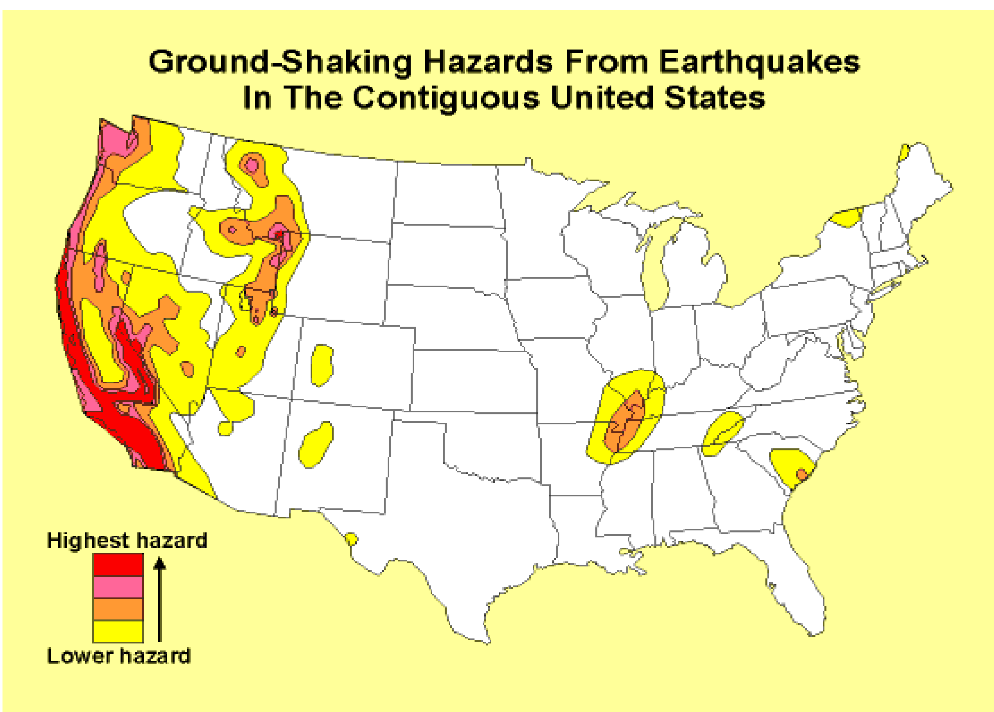
Geology and soils are those earth resources that may be described in terms of landforms, geology, and soil conditions. The makeup of geology and soils, including freshwater and marine sediments, could influence erosion, depletion of mineral or energy resources, seismic risk or landslide, structural design, and soil and ground water contamination resulting from proposed construction and operational activities.

Geology is the study of the composition and configuration of the Earth's surface and subsurface features. The general shape and arrangement of a land surface, including its height and the position of its natural and man-made features, is referred to as topography. The topography of the land surface can influence erosion rates and the general direction of surface water and ground water flow. Ground water is stored and transmitted underground in aquifers that supply lakes and rivers and is often used for human purposes, such as drinking water and irrigation for crops.

Geologic conditions also influence the potential for naturally occurring or human-induced hazards, which could pose risk to life or property. Such hazards could include phenomena such as landslides, flooding, ground subsidence, volcanic activity, faulting, earthquakes, and tsunamis (tidal waves). The potential for geologic hazards is described relative to each biome type's geologic setting. Exhibit 3-5 shows the geographic distribution for earthquakes in the continental U.S. Exhibit 3-6 shows landslide areas in the continental U.S.

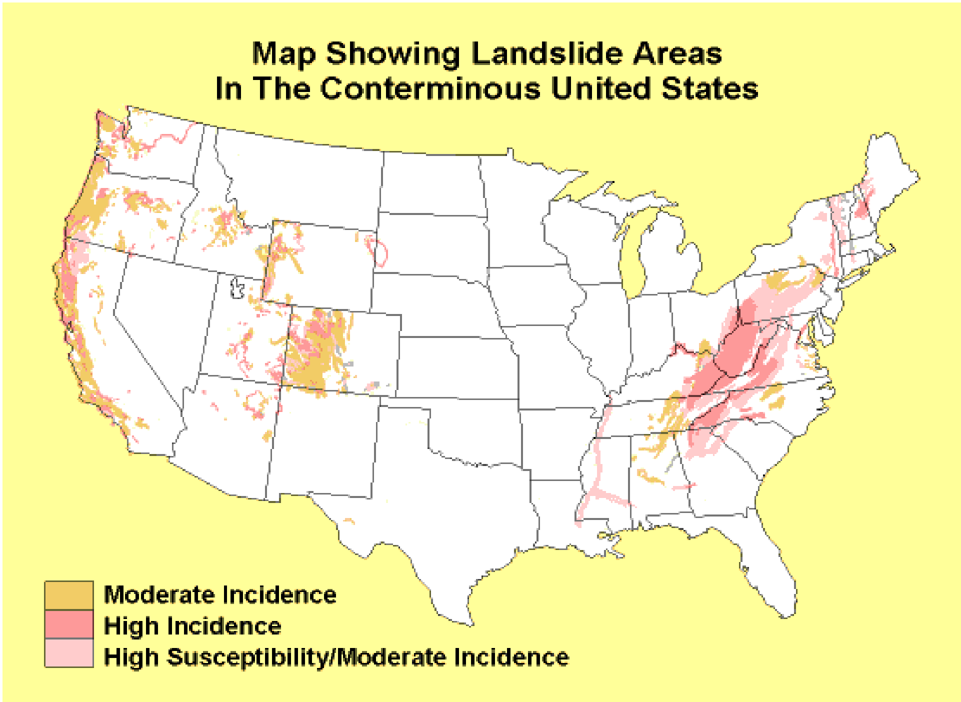
Soils and sediments are the unconsolidated materials overlying bedrock or other parent material. Soils and sediments typically are described in terms of their composition, slope, and physical characteristics. Differences among soil and sediment types in terms of their structure, elasticity, strength, shrink-swell potential, and erosion potential affect their

Exhibit 3-5. Geographic Distribution for Earthquakes in the Continental U.S.



Source: U.S. Geological Survey (USGS), 2002b

Exhibit 3-6. Landslide Areas in the Contiguous U.S.



Source: USGS, 2002d

abilities to support certain applications or uses. In appropriate cases, soil and sediment properties must be examined for their compatibility with particular construction activities or types of land use. In a limited number of cases, the presence, distribution, quantity, and quality of mineral resources might affect or be affected by a proposed action.

Impact Assessment

Site preparation activities such as grading, vegetation removal, and reseeding, as well as construction, operation, transportation and intercept debris could cause ground disturbances, and therefore could impact geology and soils. Ground disturbances should be assessed for potential impacts such as substantial erosion, siltation, landslides or slumps, soil compaction, or impacts to permafrost areas. In addition, ground disturbances could impact valuable mineral deposits or prime or unique farmland (see Section 3.1.9, Land Use). Off-road vehicle activities for debris recovery or other activities could impact soils as well. The potential for impacts depends upon the geology and topography of the area. Seismic activity within a region of influence should be evaluated and standard measures for seismic safety implemented. For example, construction activities should consider information bearing on seismic design and construction standards, and a design engineer and geotechnical consultant should consider surface faulting potential. Some test activities could impact the stability of seismically active areas. The handling of propellants and other chemicals, as well as launch impacts, should be assessed for potential spills or ground cloud effects of contaminating soils. Best Management

Practices should be identified in the impacts analysis. For example, frequent watering of excavated material and/or use of soil additives to bond exposed surface soils would reduce potential for soil erosion. The analysis also should evaluate the potential for debris craters in impact zones, including impacts to ocean sediment. For test activities, a qualified accident response team would be available near launch locations to minimize any adverse effects from an unlikely event such as flight termination.

Determination of Significance

Actions that would result in uncontrolled soil erosion, uncontrolled contamination of soil, disruption of more than one-acre of permafrost soil, or that would increase the geologic seismic instability of an area would be considered significant.

3.1.7 Hazardous Materials and Hazardous Waste

Definition and Description

Hazardous materials and hazardous waste are defined by a number of U.S. regulatory agencies. In general, hazardous materials and hazardous waste include substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to the public health, welfare, or the environment when released. The EPA regulates hazardous chemicals, substances, and wastes under the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the Toxic Substances Control Act. In addition, the Occupational Safety and Health Administration (OSHA) has definitions and workplace safety-related requirements and thresholds for listed "hazardous and toxic substances,"[37] and the U.S. DOT has definitions and requirements for the safe transport of "hazardous materials."[38]

Hazardous Materials Management

Hazardous materials management is the responsibility of the cognizant authority operating facilities, installations or ranges. Maintenance and flight support operations at various locations may require the use of products containing hazardous materials, including paints, solvents, oils, lubricants, acids, batteries, fuels, surface coatings, and cleaning compounds. These products would be used and stored at appropriate locations throughout each site, but would be primarily associated with industrial and maintenance activities. Site-specific plans would outline the strategies and procedures for storing, handling, and transporting hazardous materials, as well as responding to on-site or off-site spills.

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[37] OSHA, 2003
[38] DOT, 2003

Hazardous Waste Management

Federal and state regulations require that hazardous waste be handled, stored, transported, disposed of, or recycled in compliance with applicable regulations. Aircraft and vehicle maintenance, fuel storage and dispensing, and facility and grounds maintenance activities are MDA activity operations that could generate hazardous wastes. The sources of hazardous waste include waste fuel, chemical simulants, laser chemicals, waste oils, spent solvents, paint waste, and used batteries. Site-specific procedures and plans would outline the steps for appropriate management of hazardous wastes, such as satellite accumulation points and properly labeled DOT approved containers. Wastes may be disposed of using designated hazardous waste accumulation facilities or private hazardous waste contractors, as needed.

Impact Assessment

BMDS activities that could involve impacts from hazardous materials transport, disposal, storage, handling, and hazardous waste generation include site preparation and construction, prelaunch, launch/flight, and postlaunch activities and activation of laser weapons, sensors, and C2BMC. Site preparation activities could include exposure to previously contaminated sites. Missile build-out, fueling operations, or construction also may result in the handling of hazardous materials. The analysis should address the use of any ozone-depleting substances, such as refrigerants or foams.

Other toxic, corrosive, or flammable materials that personnel or environmental resources may be exposed to include asbestos, polychlorinated biphenyls, lead-based paint, radon gas, pesticides, petroleum and oils, chemical simulants, and propellants.

Any hazardous waste generated would be disposed of per appropriate state and Federal regulations. Federal military ranges would have established instructions to ensure proper handling and use of hazardous materials. Personnel involved in such operations would be trained in the appropriate procedures to handle hazardous materials and would wear protective clothing and receive specialized training in spill containment and cleanup. Any spills would be handled using established cleanup procedures. All tasks would be performed in accordance with standard operating procedures, and would include provisions for proper handling of hazardous materials/wastes and waste minimization.

Determination of Significance

Actions that would result in uncontrolled generation of hazardous materials or waste, actions that would require hazardous materials and do not have a closure or decommissioning plan, actions that would conflict with existing RCRA or other hazardous material or waste regulations, or actions that would expose the general public, unprotected MDA personnel, or wildlife to hazardous materials or waste that would result

in human or ecological health risk levels greater than 1 x 10^{-6} would be considered significant.

3.1.8 Health and Safety

Definition and Description

Health and safety includes consideration of any activities, occurrences, or operations that have the potential to affect the well being, safety, or health of workers or members of the general public. The primary goal is to identify and prevent accidents or impacts to on-site workers and the general public. In terms of the proposed action and alternatives, safety and health risks would occur primarily from accidents during construction, testing, operation, maintenance, or decommissioning activities. Safety and health risks may also occur from exposure to debris produced during test activities. The health and safety resource area addresses both occupational and environmental health and safety.

Occupational Health and Safety

Occupational health and safety deals with work sites and operational areas where workers would be located. (DOT, 2002) Typical potential hazards and accidents include

- Explosions of flammable liquids, solids, or compressed gases;
- Fires;
- Failures leading to fires or explosions involving boosters or other launch assets;
- Electrocution and burns from electrical equipment and currents;
- EM emissions (radars, lasers, infrared sensing devices);
- Inhalation or dermal exposure to hazardous materials or waste;
- Spills of chemicals and propellants;
- Falling debris related to construction and decommissioning;
- Confined spaces;
- Falls from structures;
- Accidents related to earth moving equipment and power tools; and
- Transportation accidents.

Hazard analyses are performed to identify and assess credible accident scenarios at work sites. The findings of a hazard analysis are used to establish health and safety procedures to prevent accident occurrences and to report and respond to any accidents that do occur.

Environmental Health and Safety

Environmental health and safety considers environmental quality both on and off the work site and operational areas that could impact the human health of the general public. Typical potential hazards and accidents include

- Explosions of flammable liquids, solids, or compressed gases;
- Fires;
- EM emissions (radars, lasers, infrared sensing devices);
- Spills of chemicals or propellants that contaminate surface or ground water;
- Inhalation of hazardous particulate and gaseous materials;
- Chronic/acute exposures to toxic/hazardous materials;
- Failures of electrical grids;
- Falling debris (e.g., from interceptor tests);
- Transportation accidents; and
- Personnel injury and equipment damage due to electrical shock.

Risk assessments are performed to identify, characterize, quantify, and evaluate risks to human health and the environment. A risk assessment considers both the likelihood or probability of occurrence and the consequences of accidents and hazardous events, including catastrophic ones. The results of a risk assessment are used to establish preventative and mitigating measures to reduce the risks to environmental quality and human health. Consideration of risk would also include debris modeling and analysis to determine the potential impact area in the event of a launch failure (including those launches requiring use of an FTS).

Impact Assessment

MDA activities with the potential to impact the health and safety of workers include construction; radar activation, laser weapon activation, missile storage, assembly, and transfer; and launch and post-launch activities. Any debris recovery and emergency operations also could impact worker health and safety. The areas of potential impacts to the health and safety of the public include prelaunch transport of missiles, launches, radar activation, laser activation, and missile flight. The potential impacts of a launch failure should be analyzed. Launch failure could involve an explosion, falling missile debris, release of toxic materials into the air or water, high noise levels, and/or fire.

Handling and assembly of missile components, which are typically accomplished within enclosed buildings, have the potential to affect worker health and safety. Range Commanders Council Standard 321-02 limits the collective risks to 1×10^{-3} for non-mission essential personnel and to 1×10^{-2} for mission essential personnel. If a launch site malfunction occurs, it could result in the scattering of the resulting missile debris anywhere within the LHA. A probabilistic risk analysis would be performed before each flight test to determine that individuals of the general public would not be exposed to a probability of fatality greater than 1 in 10 million for any single mission and 1 in 1 million on an annual basis, as per the Range Commander's Council Standard 321-02. Site-specific environmental documents would identify and, if appropriate, analyze required health and safety regulations for individual sites where activities for the

proposed BMDS may occur. Compliance with Federal, state and local regulations would be required.

Federal military ranges would have specific regulations to ensure the health and safety of members of the range as well as the public in the surrounding area. Applicable safety regulations would be followed in the transport, receipt, storage, and handling of hazardous materials. All shipping would be conducted under DOT regulations. Transportation and loading practices would meet Federal, state, and local regulatory and safety requirements.

Determination of Significance

Actions that would not fall under the existing health and safety operating procedures of the facility or range where such actions would occur, actions that would conflict with existing OSHA regulations, or actions that would result in a level of risk that exceeds the Range Commanders Council Standard 321-02 to the health and safety of the general public and MDA personnel would be considered significant.

3.1.9 Land Use

Definition and Description

Land use is described as the human use of land resources for various purposes, including economic production, natural resource protection, or institutional uses. Land uses frequently are controlled by management plans, policies, ordinances, and regulations that determine the uses that are permissible or protect specially designated or environmentally sensitive areas (e.g., prime farmlands, coastal zones, national parks, historic properties). Planning departments at the local and municipal level typically designate land uses for specific areas, which describe the permitted development activities that are acceptable for the area, such as agricultural, residential, commercial, and industrial.

Public land may be assigned specific designations for which land use and management guidelines are provided. These designations include

- Controlled use or wilderness areas;
- Limited use areas, which protect sensitive, natural, ecological, scenic, and cultural resource values;
- Low intensity regions, which carefully control multiple uses of resources and ensure sensitive values are not significantly diminished;
- Moderate use regions, which provide for a controlled balance between higher intensity uses and resource protection; and
- Intensive use regions, which provide for concentrated use of lands and resources to meet human needs.

Types of land use include agriculture, livestock grazing and production, conservation and recreation sites, military installations, and research sites managed by other agencies and organizations. A particular environment may include cities, towns, and rural communities of all sizes, throughout which are extensive communication systems; industrial complexes with factories and power plants; energy distribution systems for electricity, natural gas, liquid fuels, and nuclear, solar, hydro, and wind power; water treatment facilities; and waste management facilities. Wildlife refuges, national landmarks, and coastal zones present within an environment typically are afforded special status or protection.

A given site for proposed BMDS activities may include launch sites, impact areas, instrumentation sites, facilities, and equipment. On-site land use designations may include flight line zones, test ranges, support service areas, and explosive hazard zones. Land use categories for each site may be defined independently. Differences in terminology for land use classification among facilities where activities for the proposed BMDS may occur can be attributed to the local nature of land use classification, the unique circumstances at a particular facility, or the different interpretations of widely used terms (e.g., industrial, open space). Each land use category depends on a variety of factors, including the level of residual hazards and the risks associated with potential exposures.

The combined efforts of state, county, local, and on-site plans may regulate land use within the boundaries of a particular installation. Facilities where proposed BMDS activities may occur may use a wide range of planning documents as their land use plans, including legal settlement agreements narrowly tailored to designating land uses; comprehensive site plans incorporating all planning information, including current and future land uses, budget projections, and institutional plans; and a hierarchy of multiple planning documents. Wide variation in the level and types of coordination between site personnel and off-site communities regarding land use planning issues may occur. The variation appears to depend on the site's mission, closure schedule, proximity to local off-site development, and level of community interest. On-site land use management plans may address the security of essential mission activities from encroachment and the protection of both human and natural environments.

Impact Assessment

Numerous land use designations may characterize a given environment and the sites located within that environment. As a result, site-specific analysis will identify and, if appropriate, analyze potential impacts to particular land use designations for individual sites where activities for the proposed BMDS may occur. Compliance with Federal and state regulations and local land use plans would be required. Site-specific analysis would be coordinated with the appropriate agencies, including the Bureau of Land Management, National Park Service, U.S. Department of Agriculture Forest Service, and state agencies,

as well as county and municipal planning groups and local communities. At some facilities, it may be necessary to address the issue of encroachment to ensure that off-site development is not encroaching on the site where activities for the proposed BMDS may occur.

Determination of Significance

Actions that would require modification to an existing land use plan of an installation or range, or would preclude existing land use activities at lands adjacent to the action that are not owned by DoD or for which no easement exists between the land owner and the DoD for longer than one week, actions that would disrupt or divide established land use configurations or represent a substantial change in existing land uses, actions that would require the use of other Federal lands where an existing use agreement has not been prepared and authorized by both Federal Agencies, or conflict with existing regulations and policies governing land use (e.g., Coastal Zone Management Act) would be considered significant.

3.1.10 Noise

Definition and Description

Noise is often defined as unwanted or annoying sound that is typically associated with human activity. Most sound is not a single frequency, but rather a mixture of frequencies, with each frequency differing in sound level. The intensities of each frequency combine to generate sound, which usually is measured and expressed in decibels (dB). Decibels are measured on a logarithmic scale, which means that a doubling of sound energy or number of sources producing the same sound level will result in a three dB increase. A 3 dB increase is considered just noticeable to most people, while a 10 dB increase is considered a doubling of perceived loudness.

- **A-weighted decibels (dBA)**. Most measures of noise for community planning purposes use dBA, which are used to characterize noise as heard by the human ear.

- **Community Noise Equivalent Level**. The Community Noise Equivalent Level describes the average sound level during a 24-hour day in dBA. For noises occurring between 7:00 p.m. and 10:00 p.m., five dBA are added to the measured noise level, and for noises occurring between 10:00 p.m. and 7:00 a.m., 10 dBA are added to the measured noise level.

- **Day night average noise level (DNL)**. DNL is the energy average noise level during a 24-hour day. It is reported in dBA and is used to predict human annoyance and community reaction to unwanted sound (noise). Because humans are typically more

sensitive to noise in the evening, the DNL places a 10-dBA penalty on noise produced between the hours of 10:00 p.m. and 7:00 a.m.

- **Equivalent Noise Level (L_{eq})**. The L_{eq} is the energy average A-weighted sound level during a stated measurement period. It is used to describe the time-varying character of environmental noise.

- **Pounds per Square Foot**. Pounds per square foot is a measure of pressure. Some activities of the proposed BMDS may produce pressure waves in the form of sonic booms that can cause damage to eardrums and structures.

Examples of A-weighted noise levels for various common noise sources are shown in Exhibit 3-7.

Exhibit 3-7. Comparative A-Weighted Sound Levels

Noise Level (dBA)	Common Noise Levels	
	Indoor	**Outdoor**
100 – 110	Rock band	Jet flyover at 304 meters (997 feet)
90 – 100	Food blender at one meter (three feet)	Gas lawnmower at one meter (three feet)
80 – 90	Garbage disposal at one meter (three feet)	Diesel truck at 15 meters (49 feet) - Noisy urban daytime
70 – 80	Shouting at one meter (three feet) Vacuum cleaner at three meters (ten feet)	Gas lawnmower at 30 meters (98 feet)
60 – 70	Normal speech at one meter (three feet)	Commercial area heavy traffic at 100 meters (328 feet)
50 – 60	Large business office Dishwasher next room	
40 – 50	Small theater (background) Large conference room (background)	Quiet urban nighttime
30 – 40	Library (background)	Quiet suburban nighttime
20 – 30	Bedroom at night	Quiet rural nighttime
10 – 20	Broadcast/recording studio (background)	
0 – 10	Threshold of hearing	

Source: Modified from FAA, 2001

Noise from transportation sources, such as vehicles and aircraft, and from continuous sources, such as generators, would be assessed using the A-weighted DNL. The A-

weighted DNL significantly reduces the measured pressure level for low-frequency sounds, while slightly increasing the measured pressure level for some high-frequency sounds. Noise from small arms ranges is assessed using the A-weighted DNL. Impulse noise resulting from armor, artillery, and demolition activities is assessed in terms of the C-weighted DNL. The C-weighted DNL is often used to characterize high-energy blast noise and other low frequency sounds capable of inducing vibrations in buildings or other structures. The C-weighted scale does not significantly reduce the measured pressure level for low frequency components of a sound.

Impact Assessment

The acceptability of noise depends in part on expectations associated with land use. An urban environment is noisier than a suburban environment, and a suburban environment is noisier than a rural one. Exhibit 3-8 provides a range of DNL values by land use type.

Exhibit 3-8. Examples of Outdoor Day-Night Average Noise Levels in Various Land Use Locations

Outdoor Location	DNL in dB
Apartment next to freeway	88
¾ mile from touchdown at major airport	86
Downtown with some construction activity	79
Urban high density apartment	78
Urban row housing on major avenue	68
Old urban residential area	59
Wooded residential	51
Agricultural crop land	44
Rural residential	39
Wilderness ambient	35

Source: EPA, 1978

Exhibit 3-9 lists noise measurements that were recorded at some existing facilities where launch activities have taken place, which encompass various environmental settings.

Site-specific analysis would identify and, if appropriate, analyze potential impacts from noise levels at individual sites where activities for the proposed BMDS may occur. Noise impacts resulting from activities associated with the proposed BMDS may include but are not limited to construction activities, missile launches, and use of generators. Three types of receptors are typically analyzed: humans, wildlife, and structures. For each type of receptor, the potential impacts of noise would need to be analyzed in site-specific analyses.

Exhibit 3-9. Range of Noise Measurements

Measurement Locations		Noise Level (dBA)
Remote desert environments[39]		22-38
Interstate interchanges (non-urban)[40]		55-70
Marshall Space Flight Center (wooded area with insects dominating the higher reading)[41]		40-54
Vandenberg AFB[42]		48-67
Edwards AFB (with some areas off base at 80 dBA)[43]		65-85
WSMR[44]	Main post	55-65
	Property boundary	45-55
	Nearby San Andreas National Wildlife Refuge	45
Eastern Range[45]		60-80
KLC[46]	Approximately 1,905 meters (6,250 feet) from center of pad	95
	Distance of 9 to 24 kilometers (5.6 to 15 miles) from the launch pad	70

Source: Modified from DOT, 2001b

Launch Activity Noise

Noise during launch activities would occur due to the rocket engine. Noise generated during launch would result from the interaction of the exhaust jet with the atmosphere and the combustion of the fuel. The sound pressure from a missile is related to the engine's thrust level and other design features. Workers exposed to excessive launch noise would be required to wear hearing protection.

Sonic booms also would be generated during launches when the launch vehicle reached supersonic speed. A sonic boom is a sound that resembles rolling thunder, and is produced by a shock wave that forms at the nose of a vehicle that is traveling faster than

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39 Estimate, no other specifics given
40 Monitoring data, no other specifics given
41 One-hour monitoring
42 Twenty-four hour monitoring
43 Monitoring data, no other specifics given
44 Estimate, no other specifics given
45 Daytime monitoring
46 Rocket noise levels from launch of U.S. Air Force atmospheric interceptor technology test vehicles

the speed of sound. The sound heard at the Earth's surface as the "sonic boom" is the sudden onset and release of pressure after the buildup by the shock wave or "peak overpressure."

Construction Noise

In addition to operational noise, construction would result in intermittent, short-term noise effects that would be temporary, lasting for the duration of the noise generating construction activities. Noise-generating construction activities would include excavation and grading, utility construction and paving, and frame building. The specific types of equipment that would be used during construction would be identified in site-specific analyses. Excavation and grading would normally involve the use of bulldozers, scrapers, backhoes, and trucks. The construction of buildings likely would involve the use of pile drivers, concrete mixers, pumps, saws, hammers, cranes, and forklifts.

Power Generation Noise

The use of power generators should not exceed locally regulated noise levels or facility specific noise levels. The noise associated with generators would be controlled by use of standard silencing packages (mufflers) provided by the manufacturer and routine maintenance and inspection of such systems.

<u>Human Response</u>. Noise from single events can be annoying due to noise level, duration of the event, how loud the event is relative to ambient sound levels, and the frequency of occurrence. Additional annoyance can be attributable to a 'startle effect' associated with a sonic boom. Site-specific analysis will identify and, if appropriate, analyze potential impacts from noise levels at individual sites where activities for the proposed BMDS may occur. Compliance with Federal as well as state and local regulations will be required. (EPA, 1978, as referenced in DOT, 2001b)

The annoyance experienced as a result of sonic booms has been widely studied both in the field and in laboratory settings. Annoyance is generally considered to be a function of boom intensity, number of booms per time period, attitude of the population, and the activity in which people were engaged in at the time of the boom. However, there is no precise relationship between the parameters. One study was done to determine the reactions of people routinely exposed to sonic booms (eight sonic booms per day) over a six-month period. This study found that sonic boom annoyance increases as the number and or level of sonic booms increases. (DOT, 2001b) In that study, approximately 20 percent of the population reported annoyance from sonic booms with median peak overpressures of 0.5 psf. Another study suggested that prior experience with sonic booms (such as people who live on an AFB) seems to lower sensitivity to sonic booms. (DOT, 2001b) Other factors that influence the loudness and annoyance are the rise time of the sonic boom and shape of the waveform. (DOT, 2001b) In general, some public

reaction can be expected if occasional sonic booms with peak overpressures between 1.5 and 2 psf impact populated areas (NASA, 1994), but it is possible that at lower amplitudes people can express annoyance to sonic booms. The impacts assessment would include the number, frequency, location, and intensity of sonic booms, and identify affected receptors.

Structural Response. Sonic booms also may cause structural damage, which could impact prehistoric and historic resources. Vibrations from the sonic booms could disturb existing cultural and historic structures, especially those that are not structurally sound. The impacts assessment would identify and evaluate effects on existing cultural resources and historic structures.

Wildlife Response. Responses of wildlife would vary based on the type of noise and its characteristics (amplitude, rise time, duration, frequency content), the species of wildlife, hearing capability, location, habitat type, current activity of the animal, sex and age, previous experience with noise exposure, and condition of the animal. (Manci, 1988) Potential physiological impacts from noise can range from short-term mild impacts, such as an increase in heart rate or small temporary changes in hearing, to more damaging impacts, such as permanent changes in hearing, metabolism, and hormone balance, to long-term severe impacts, such as chronic distress that is harmful to the health of wildlife species and their reproductive fitness. (DOT, 2001b) Potential behavioral impacts from noise also range greatly from minor responses, including small changes in current behavior such as, a “heads up” response, to more severe responses, such as panic and escape flight responses that might result in physiological damage (falling, trampling, crashing, piling). Behavioral responses of wildlife to noise also can accompany physiological responses. The impacts assessment would identify and evaluate effects on affected wildlife, including threatened and endangered species and migratory populations.

Hearing Damage

The OSHA regulation 1910.95 establishes a maximum noise level of 90 dBA for a continuous eight-hour exposure during a working day and higher levels for shorter exposure time in the workplace. The OSHA standards allow for a 5 dBA increase in sound level for a 50 percent reduction in exposure time. Therefore, the maximum noise exposure permitted under the regulation for continuous exposure would be 115 dBA for 15 minutes. (FAA, Aviation Noise Effects, 1985) Other standards have also been recommended for exposure to continuous noise. The EPA has recommended an average L_{eq} of 70 dBA for continuous 24-hour exposure to noise to protect hearing. This level is considered conservative and is based on the probability of negligible hearing loss, defined as less than 5 dB in 100 percent of the exposed population, at the human ear’s most sensitive frequency (4,000 hertz) after a 40-year exposure. (FAA, 1985) Noise also

may be impulsive in nature. Under OSHA regulation 1910.95 exposure to impulse noise should not exceed 140 dBA.

Determination of Significance

Federal and state agencies that regulate noise handle the determination of significant noise impact differently. For example, the FAA considers the threshold of a significant impact to be a 1.5 dBA increase from 65 DNL (FAA Order 1050.1E) Federal Highway Administration (FHWA) does not employ significance thresholds for noise; rather, FHWA uses Noise Abatement Criteria (NAC) where noise abatement is considered (where reasonable and feasible) for EISs as well as EAs. The NAC vary by land use—the residential NAC is 66 dBA, 1 hour L_{eq}. FHWA considers both absolute and relative noise impacts. A relative noise impact refers to the amount of project-related noise increase above ambient noise levels.

Potential BMDS noise impacts could be associated with a wide range of noise sources and noise environments. For example, a generator produces a steady-state noise, with moderate noise levels and limited geographic effect. A missile launch could produce high noise levels for a short duration with little to no exposure in populated areas. Because NEPA requires ‘context and intensity’ in consideration of significant impact, these disparate noise situations potentially call for different definitions of significance. Therefore, the details of what would comprise a ‘significant’ noise impact for the PEIS will be developed and considered on a case-by-case basis.

3.1.11 Socioeconomics

Definition and Description

Socioeconomics is defined as the basic attributes and resources associated with the human environment, in particular population and economic activity. Socioeconomic resources consist of several primary elements including population, employment, and income. Other socioeconomic aspects that are described often may include housing and employment characteristics, and an overview of the local economy.

Impact Assessment

Potential socioeconomic impacts from MDA activities may stem from construction or operation of the BMDS. The magnitude of the impacts would depend on the duration and extent of displacement or modification of existing activities and the diversion or temporary suspension of access. Impact analyses should focus on the following broad areas of economic or social impacts: employment and income; growth inducement; potential impacts to locally significant industries such as tourism, commercial fishing, or

agriculture; displacement of populations, residences, or businesses; and housing or accommodation availability.

Employment and Income

Activities for the proposed BMDS could have a positive economic impact in local communities due to increased jobs in the defense industry. These jobs generally are technology-based and require workers with specialized skills and education. These jobs would contribute to local economies by increasing personal income, thereby increasing the tax base. In addition, an increase in workers in a particular area increases the need for services, which creates more jobs in other industries, such as retail, food services, education, and health.

Local Economies

Additional construction personnel, by spending money in the local economy, mainly via accommodation and procurement of goods and services, would represent both a potential increase in local service-based employment opportunities and a small but positive temporary economic impact to the local community. Site-specific documentation would be required for comprehensive analysis of impacts to local economies.

Displacement Impacts

Some missile defense activities could result in a negative economic impact from displacement of populations, residences or businesses; housing or accommodation availability. For example, health care facilities, housing, and other infrastructure may be insufficient in some areas to support an influx of workers during construction. Testing and operation activities also may require an influx of additional personnel into the area. Proposed activities also could cause displacement of populations during test events and potential impacts to local industries such as tourism, or agriculture due to the closure of these areas during test events. Proposed activities could cause a loss in property value due to adjacent test activities. Site-specific analyses would be required to determine the magnitude of the potential for impact.

Determination of Significance

Significant economic or social impacts do not require preparation of an EIS unless those impacts are combined with significant impacts from other resource categories (see 40 CFR 1504.14). Actions that would disrupt local or regional economies or would displace or introduce a new population that would substantially alter the socioeconomic setting, or actions that would cause a ten percent increase in the risk of crime or other undesirable social factors would be considered significant.

3.1.12 Transportation

Definition and Description

The transportation section addresses ground, air, and marine transport systems.

According to the most recently available data, the U.S. has over four million miles of highways, railroads, and waterways that connect all parts of the country. It also has 19,000 public and private airports and approximately 1.6 trillion miles of oil and gas distribution pipelines. This extensive transportation network supported about 4.9 trillion passenger-miles of travel in 2001 and 3.8 trillion ton-miles of commercial freight shipments in 2001. The U.S. transportation system, one of the world's largest, serves 284 million residents and seven million business establishments. (DOT Bureau of Transportation Statistics [BTS], 2003)

Metropolitan areas are characterized by urban transit, a complex mix of heavy, light, and commuter rail; buses and demand responsive vehicles; ferries; and other less prevalent types such as inclined planes, trolley buses, and automated guide ways. More than one-third of America's population lives outside of urbanized areas, which typically do not have extensive transit systems.

Paved roadways constituted about 65 percent of all highway mileage in 2001. Nearly all of the public roads in U.S. urban areas are paved, however, about half of the miles of rural public roads are unpaved. In 2001, 71 percent of U.S. roads were classified as being in good or very good condition and 14 percent as mediocre or poor. The remaining 15 percent were classified as fair. The generally poorer condition of urban roads, as compared with rural roads, can be attributed to the higher levels of traffic they carry. (DOT BTS, 2003) Urban roads handled about 60 percent of all traffic in 2000 with far fewer miles of road. (DOT BTS, 2001)

The most heavily populated states, California, Texas, Florida, and New York, are the most heavily traveled. However, Wyoming, the least populated state, had the highest vehicle-miles of travel per capita in 2000 at 16,400, followed by Georgia, Alabama, Oklahoma, and New Mexico at over 12,500. The District of Columbia and New York had the lowest vehicle-miles of travel per capita at less than 7,000. (DOT BTS, 2001) Landside access to water ports comprises a system of intermodal rail and truck services. Landside congestion, caused by inadequate control of truck traffic into and out of port terminals combined with the lack of adequate on-dock or near-dock rail access, affects the productivity of U.S. ports and the flow of U.S. international trade. Changes in vessel design impact access to both landside and waterside services. For example, container vessels have increased in size and capacity, which, in turn, drives a need for adequate trans-shipment hub and feeder ports.

Ground Transportation

Ground transportation and traffic circulation refer to the movement of vehicles from origins to destinations through a road and rail network. Roadway operating conditions and the adequacy of the existing and future roadway system to accommodate these vehicular movements usually are described in terms of the volume-to-capacity ratio, which is a comparison of the average daily traffic volume on the roadway to the roadway capacity. The volume-to-capacity ratio corresponds to a Level of Service (LOS) rating, ranging from free-flowing traffic conditions (LOS A) for a volume-to-capacity of usually less than 30 percent of the roadway capacity to forced-flow, congested conditions (LOS F) for a volume-to-capacity of 100 percent of the roadway capacity. LOS A, B, and C are considered good operating conditions where motorists experience minor delays. LOS D represents below average conditions, and LOS E corresponds to the maximum capacity of the roadway. LOS F indicates a congested roadway.

Railway operating conditions and safety standards in the U.S. are regulated by the U.S. DOT, Federal Railroad Administration. The Federal Railroad Administration has established standards for nine types of track (Class 1 through 9); each class has unique construction, maintenance, and inspection standards, as well as operational requirements. Class 1 track is the minimum acceptable standard for general use and has a 16 kilometer per hour (ten mile per hour) speed limit for freight and a 24 kilometer per hour (15 mile per hour) speed limit for passengers. Class 9 track has the most stringent track standards and allows both freight and passenger trains to travel up to 322 kilometers per hour (200 miles per hour). Local regulations, e.g., city speed limits, may reduce speeds regardless of track quality. (DOT, FRA 2002)

Air Transportation

Air transportation refers to the movement of aircraft through airspace. The control of airspace used by air traffic varies from very highly controlled to uncontrolled areas. Examples of highly controlled air traffic situations are flight in the vicinity of airports, where aircraft are in critical phases of flight (take-off and landing), flight under IFR, and flight on the high or low altitude route structure (airways). Less controlled situations include flight VFR or flight outside of U.S. controlled airspace (e.g., flight over international waters off the coast of California, Hawaii, or Alaska).

Marine Transportation

Marine traffic is the transportation of commercial, private, or military vessels at sea, including submarines. Marine traffic flow in congested waters, especially near coastlines, is controlled by the use of directional shipping lanes for large vessels (cargo, container ships, and tankers). Traffic flow controls also are implemented to ensure that harbors and ports-of-entry do not become congested. There is less control on ocean

traffic involving recreational boating, sport fishing, commercial fishing, and activity by naval vessels. However, U.S. Navy vessels follow military procedures and orders (e.g., Fleet Forces Command) as well as Federal, state, and local marine regulations. In most cases, the factors that govern shipping or boating traffic include adequate depth of water, weather conditions (primarily affecting recreational vessels), the availability of fish of recreational or commercial value, and water temperature (higher water temperatures will increase recreational boat traffic and diving activities).

Impact Assessment

General transportation impacts can be assessed by determining the existing traffic flow and LOS. MDA activities that could cause impacts to the LOS include the increased delivery of construction equipment, propellants, or test event equipment, and the influx of construction workers or test operation personnel. In addition, roads, ports, or waterways within the LHA may be closed during test events. Roads also may be closed during the arrival of missile payloads and/or boosters to ensure that roadways near a Range would be vacated.

The region of influence in determining impacts would depend on local traffic volume and transportation infrastructure. At the programmatic level, analysis shows that construction events and associated increases in transport of equipment and personnel are typically short-lived. However, site-specific analyses should be completed to determine local conditions.

Determination of Significance

Actions that are not included as categorical exclusions in DoD's NEPA implementing regulations, or actions that would require the movement of an extremely hazardous, toxic or radiological substance, would generate traffic levels that would require construction of new roadways or expansion of existing roadways, alteration of circulation patterns, or would result in inadequate parking, transportation actions that would result in multi-day disruptions (more than two days) of marine or air traffic shipping lanes would be considered significant. In addition, actions that would result in road closures for more than two days or closures of major highways for more than one hour during peak traffic hours would be considered significant.

3.1.13 Utilities

Definition and Description

The purpose of the utilities section is to address the existing rate of consumption, generation, and distribution of utilities, which include energy, water, wastewater, and solid waste and construction debris. This section address those facilities and systems that

provide power, water, wastewater treatment, the collection and disposal of solid waste, and other utility services.

- **Energy**. Energy refers to the power that is produced by a central electrical power plant or, in some cases, by individual power generators. The power would be utilized for both construction and operational activities on different sites.

- **Water**. Water refers to the system that produces water, the treatment system that purifies the water, and the network that distributes that water. This water system usually is controlled, managed, and distributed by an entity such as a utility purveyor. In the absence of a water system, individualized water wells or a series of wells meet the demand for water. The water system is identified by potable, or drinkable, freshwater and nonpotable water used for other activities such as construction, operations, and irrigation. In some cases the non-potable system is saltwater. The water system is composed of a source that produces the water and the treatment systems that cleanse and purify it, making it available for use. Water made available to the public must meet EPA standards as described in Section 3.1.15.

- **Wastewater**. There are different methods of treating wastewater that is produced by a site. Wastewater can be collected in a central system and then directed to a treatment plant where it can be treated and then discharged. In many instances, the wastewater is further treated and reclaimed for use as nonpotable water. In the absence of a central system, septic systems collect and treat water either individually (individual households) or collectively (within a community).

- **Solid Waste**. Solid waste disposal includes the collection, handling, and disposal of waste. Designated landfills within an area or region are the final destinations where solid waste and construction debris is transported for processing. Solid waste usually is processed to separate out recyclable products first. Solid waste disposal also includes practices such as open burning, septage disposal, and burial in open or excavated trenches, where allowed by law.

Impact Assessment

A site-specific impact assessment should consider whether there is adequate wastewater treatment capacity or capability and if the proposed action would exceed wastewater treatment requirements and alter the existing rate of consumption, generation, and distribution of utilities. An impact analysis should include an evaluation of waste disposal facilities and landfills and waste discharge requirements. MDA activities require consistent power sources, and depletion of an existing power supply from a central electric power plant or individual power generators should be considered. Assessment of potential impacts on utilities would include a review and analysis of

- Wastewater treatment requirements of the applicable Regional Water Quality Control Board or other governing authority;
- Availability of sufficient water supplies to serve the proposed action, or need for new or expanded entitlements;
- Availability of waste disposal facilities and landfills with sufficient permitted capacity to accommodate solid waste disposal needs;
- International treaties and Federal, state, and local statutes and regulations related to solid waste; and
- Capacity of the existing power supply providers and wastewater treatment providers to determine whether they could adequately serve the projected demand of the proposed action, in addition to the provider's existing commitments.

Determination of impacts on utilities also would include consideration of whether the proposed action would require or result in the construction of new water or wastewater treatment facilities, new storm water drainage facilities, or energy sources beyond permitted levels. Construction of new facilities or expansion of existing facilities has the potential to cause significant environmental impacts. It would be necessary to obtain appropriate permits for activities that may impact utility systems and facilities and to ensure compliance with local laws and regulations.

Site-specific analysis would be required to identify and, if appropriate, analyze potential impacts to a local utility system for individual activities for the proposed BMDS. For this reason, this PEIS will not include an analysis of the proposed BMDS activities' impacts on utilities.

Determination of Significance

Actions that would result in exceeding the existing capacity of the regional utility service providers (water supply, wastewater disposal, electricity, natural gas, solid waste disposal) and would require the identification or development of new utilities, supplies (water, electricity, natural gas), or disposal facilities (wastewater treatment facilities or solid waste disposal facilities) and their associated utility transmission corridors would be considered significant.

3.1.14 Visual Resources

Definition and Description

Visual resources are defined as the natural and man-made features that constitute the aesthetic qualities of an area. Landforms, surface water, vegetation, and man-made features are the fundamental characteristics of an area that define the visual environment and form the overall impression that an observer receives of an area. The importance of visual resources and any changes in the visual character of an area is influenced by social

considerations, including the public value placed on the area, public awareness of the area, and community concern for the visual resources in the area.

The visual resources of an area and any proposed changes to these resources can be evaluated in terms of “visual dominance” and “visual sensitivity.” Visual dominance describes the level of noticeability that occurs as the result of a visual change in an area. The levels of visual dominance vary from “not noticeable” to a significant change that demands attention and cannot be disregarded. Visual sensitivity depends on the setting of an area. Areas such as coastlines, national parks, and recreation or wilderness areas usually are considered to have high visual sensitivity, whereas heavily industrialized urban areas tend to have the lowest visual sensitivity.

The significance of visual effects is very subjective and depends upon the degree of alteration, the scenic quality of the area disturbed, and the sensitivity of the viewers. The degree of alteration refers to the height and depth of maximum cut and fill areas and the introduction of urban elements into an existing natural environment or a substantial increase of structural elements into an already urban environment, while acknowledging any unique topographical formation or natural landmark. Sensitive viewers are those who utilize the outdoor environment or value a scenic viewpoint to enhance their daily activity and are typically residents or recreation users. Changes in the existing landscape where there are no identified scenic values or sensitive viewers are considered less than significant. Also, it is possible to acknowledge a visual change as possibly adverse but not significant, because either viewers are not sensitive or the surrounding scenic quality is not high. Visual impacts also would occur if proposed development is inconsistent with existing goals and policies of jurisdictions in which the project is located.

Many environments are likely to include regions of rich aesthetic and visual resources as well as designated and undesignated natural areas of great beauty and scenic diversity. Visual resources may fall under several different designations including national forest; national monument; national, state, and county parkland; national wildlife refuges; wilderness areas; wild and scenic rivers; national trails; and privately owned land. Various roads also may be designated scenic byways due to their scenic, historic, and cultural qualities. Visually sensitive recreational areas or scenic highways may be located in close vicinity of a site where activities for the proposed BMDS may occur.

Installations where MDA activities for the proposed BMDS may occur are typically dominated by developed, high technology buildings and support facilities. Some existing military sites are relatively unobtrusive when viewed from surrounding areas; however, it is possible that a variety of visual and aesthetic resources may be located near sites where activities for the proposed BMDS may occur.

Impact Assessment

MDA activities could have aesthetic impacts associated with changes in either the built or natural environment. An impacts analysis should include the length of visual disturbance (short- or long-term).

Assessment of potential impacts on visual resources should include a review and analysis of

- Short-term visual impacts such as the presence of heavy machinery during construction of a project (large trucks, cranes, and other construction equipment would be visible within the construction zone and in surrounding areas only during the construction phase.);
- Long-term visual changes such as those associated with altering the existing visual environment by constructing buildings, including those with high vertical profiles;
- Existing scenic resource, including but not limited to trees, rock outcroppings, and historic buildings within a state scenic highway;
- Existing visual character or quality of a site and its surroundings;
- New sources of substantial light or glare, which could adversely affect day or nighttime views in the area (for example, nighttime lighting, particularly during construction can cause impacts to visual resources);
- Viewer concern, or the level of scenic importance based on expressed human concern for the scenic quality of land;
- Distance an area can be seen by observers and the degree of visible detail within that area; and
- Extent of modification that would occur as a result of the proposed action.

Numerous visual and aesthetic resources may be identified in a given environment and at or near BMDS installations located within that environment. As a result, site-specific environmental documentation will identify and, if appropriate, analyze potential impacts to visual and aesthetic resources located in the vicinity of sites where activities for the proposed BMDS may occur. For this reason, this PEIS will not include an analysis of the proposed BMDS activities' impacts on visual resources.

Determination of Significance

Actions that would be considered significant include those that involve structures or land alterations that are visually incompatible with or obtrusive to the existing visual setting and landscape, noticeably increase visual contrast and reduce the scenic quality rating, permanently block or disrupt existing views or reduce public opportunities to view scenic resources, or conflict with existing regulations and policies governing aesthetics and visual resources (e.g., National Historic Preservation Act).

3.1.15 Water Resources

Definition and Description

Water resources include surface water, ground water, and floodplains. Surface water resources consist of lakes, rivers, and streams. Surface water is important for its contributions to the economic, ecological, recreational, and human health of a community or locale. Storm water flows, which may be exacerbated by high proportions of impervious surfaces (e.g., buildings, roads, and parking lots), are important to the management of surface water. Storm water also is important to surface water quality because of its potential to introduce sediments and other contaminants into lakes, rivers, and streams.

Ground water consists of the subsurface hydrologic resources. It is an essential resource often used for potable water consumption, agricultural irrigation, and industrial applications. Ground water typically may be described in terms of its depth from the surface, aquifer or well capacity, water quality, surrounding geologic composition, and recharge rate.

Floodplains are areas of low-lying ground along a river or stream channel. Such lands may be subject to periodic or infrequent inundation due to rain or melting snow. Risk of flooding depends on topography, the frequency of precipitation events, and the size of the watershed above the floodplain. Often development in floodplains is limited to passive uses, such as recreational and preservation activities, to reduce the risks to human health and safety.

The National Water Quality Inventory summarizes the water quality assessments performed by state, local and Tribal governments. (EPA, 2000) Water quality standards consist of three elements: (1) designated uses assigned to water body (e.g., drinking, swimming, and fishing); (2) criteria to protect the designated use (e.g., chemical specific threshold limits); and (3) anti-degradation policy to prevent deterioration of current water quality. The status of the U.S. water quality in 2000 is described in Exhibit 3-10.

Exhibit 3-10. Summary of Quality of Assessed Rivers, Lakes, and Estuaries

Water Body Type	Total Size, approximate	Amount Assessed* (Percent of Total)	Good (Percent of Assessed)	Good but Threatened (Percent of Assessed)	Polluted (Percent of Assessed)
Rivers, kilometers [miles]	5.94 million (3.7 million)	19 percent	52 percent	98 percent	38 percent
Lakes, hectares [acres]	16.4 million (40.6 million)	43 percent	46 percent	8 percent	44 percent
Estuaries, square kilometers [square miles]	22,630 (87,370)	36 percent	45 percent	<43 percent	50 percent

Source: EPA, 2002
*Includes water bodies assessed as not attainable for one or more uses
Note: percentages may not add up to 100 percent due to rounding

The leading causes of impairment of rivers and streams include pathogens (bacteria), siltation (sedimentation), and habitat alterations, and the leading sources for these include agriculture, hydraulic modifications, and habitat modifications. The leading causes of impairment of lakes, ponds and reservoirs include nutrients, metals (primarily mercury), and siltation (sedimentation), and the leading sources for these include agriculture, hydraulic modifications, and urban runoff/storm sewers. The leading causes of impairment of estuaries include metals (primarily mercury), pesticides, and oxygen-depleting substances, and the leading sources for these include municipal point sources, urban runoff/storm sewers, and industrial discharges. (EPA, 2002)

Impact Assessment

MDA activities that could impact water resources include those that either alter the flow of surface water, supply of ground water, or in some way contribute foreign bodies (pollution, sediment) to these water resources.

Assessment of potential impacts on water quantity would include a review and analysis of activities that

- Increase the number of impervious surfaces in an environment such as construction of new roads, buildings, parking lots, launch pads or runways (these surfaces can impact storm water runoff and recharge of ground water sources); and

- Consume ground water or surface water for a particular facility (the availability of water resources varies between locations).

Assessment of potential impacts on water quality would also include a review and analysis of activities that result in emissions or discharge of pollutants to water resources such as

- Construction or operation activities that could contribute to the sedimentation of water bodies; and
- Causes of point and non-point source pollution such as transportation emissions and ground clouds from launch, runoff of deluge or wash down water, thermal discharges, debris impacts, and any plans for open burning/open detonation.

Individual construction projects and associated water demands cannot be considered at the programmatic level, but must be analyzed in site-specific environmental documentation that can assess the impacts of such activities. This PEIS addresses the general impacts of BMDS activities resulting in sedimentation and pollution on water resources.

Determination of Significance

Actions that would fill in jurisdictional wetlands at levels that exceed the criteria for a Nationwide Permit and would require consultation with the U.S. Army Corps of Engineers and the development and implementation of a mitigation plan would be considered significant. Actions that would violate or exceed existing National Discharge Elimination System or Total Maximum Daily Load standards or would degrade the Total Maximum Daily Load classification of a water body, or would violate existing international, Federal, or state water discharge treaties or regulations would be considered significant. Actions that occur within and do not comply with a state wellhead protection area and its management practices, a state coastal zone management program, or any new ground water or surface water extraction system that would affect the water table or flow rates that has not been coordinated with the appropriate regulatory agency would be considered significant.

3.2 Affected Environment

The Affected Environment discussion describes the particular characteristics of each resource area[47] within nine terrestrial biomes, the BOA, and the Atmosphere, which represent the land, air (atmosphere), water, and space environments where proposed BMDS activities are reasonably foreseeable. Each contains distinct plant and animal groups and political boundaries.

[47] Cultural resources, environmental justice, land use, socioeconomics, utilities and visual resources are not discussed in the biome descriptions because they are local in nature and are not analyzed in Chapter 4.

A biome is a large geographical area of distinctive plant and animal groups. The climate and geography of an area determine what type of biome can exist in that area. Major terrestrial biomes include deserts, forests, grasslands, mountains, tundra and associated surface water bodies. Major marine systems include intertidal zones (which include sandy beaches, rocks, estuaries, mangrove swamps and coral reefs), neritic zones (the relatively shallow ocean that extends to the edge of the continental shelf, where primary productivity depends on planktonic algae growing as deep as the light can reach), oceanic zones, and abyssal plains.

Detailed descriptions of the nine terrestrial biomes, the BOA, and the Atmosphere as addressed in this PEIS are found in Appendix H Biome Descriptions.

3.2.1 Arctic Tundra Biome

The Arctic Tundra Biome[48] discussion encompasses the arctic coastal regions that border the North Atlantic Ocean and Arctic Ocean. This biome includes coastal portions of the state of Alaska in the U.S., Canada, and Greenland (administered by Denmark). The global distribution of this biome is depicted in Exhibit 3-11.

The majority of the Arctic Tundra Biome is located north of the latitudinal tree line and consists of the northern continental fringes of North America from approximately the Arctic Circle northward. For example, Thule AFB, Greenland, which is located approximately 1,100 kilometers (700 miles) north of the Arctic Circle, is the northernmost installation where MDA activities for the proposed BMDS may occur. The Arctic Tundra Biome includes other coastal locations that may be situated south of the Arctic Circle but have a climate and ecosystem similar to that of inland Arctic Tundra. These sites are located on the islands of the Aleutian chain and include Eareckson Air Station, Shemya Island, Alaska, and Port of Adak, Adak, Alaska.

[48] Exhibit 3-11 shows the global location of the Arctic Tundra ecosystem. However, based on reasonably foreseeable locations for activities for the proposed BMDS to occur, the Affected Environment focuses on the coastal portions of this ecosystem.

Exhibit 3-11. Global Distribution of the Arctic Tundra Biome

Source: Modified from National Geographic, 2003a

3.2.1.1 Air Quality

The climate of the Arctic Tundra Biome is characterized as polar maritime with persistent overcast skies, high winds, frequent and often violent storms, and a narrow range of temperature fluctuation throughout the year. The average annual temperature is -28°Celsius (°C) (-18°Fahrenheit [°F]). Parts of the Arctic Tundra may be classified as desert due to low precipitation. Annual precipitation is light, often less than 200 millimeters (eight inches). Most precipitation falls as snow in October through November. However, because potential evaporation also is very low, the climate tends to be humid. The Arctic Tundra also is characterized by high winds, which can blow between 48 to 97 kilometers (30 to 60 miles) per hour.

Air quality in the Arctic Tundra Biome is considered good, however, some areas in and around urban centers are in non-attainment for CO.

3.2.1.2 Airspace

Airspace above U.S. military airfields in the Arctic Tundra Biome includes controlled airspace and operates under IFR. The Arctic Tundra Biome also includes regions that are located in international airspace and therefore, the procedures of the International Civil Aviation Organization (ICAO) are followed. Much of Alaska's aviation activity takes

place within existing MOAs, through a shared-use agreement, with information provided by the Special Use Airspace Information Service, which is a system operated by the U.S. Air Force under agreement with the FAA Alaskan Region to assist pilots with flight planning and situational awareness while operating in or around MOAs or Restricted Areas in interior Alaska. In Canada, the Air Navigation Services and Airspace Services of Transport Canada are responsible for issues involved with airspace utilization and classification, levels of service for Air Navigation Service facilities, and services, including weather, navigation, radar, and communication services. In Greenland, the Danish Civil Aviation Administration issues Notices to Airmen (NOTAMs) regarding restricted airspace.

Civilian, military, and private airports exist in the Arctic Tundra Biome. Civilian aircrafts generally fly along established flight corridors that operate under VFR.

3.2.1.3 Biological Resources

Tundra environments are characterized by treeless areas, which consist of dwarfed shrubs and miniature wildflowers adapted to a short growing season. Species resident in arctic tundra have evolved adaptations peculiar to high latitudes. Examples of land mammals found on the Arctic Tundra include shrews, hares, rodents, wolves, foxes, bears and deer. Several lakes in the Arctic Tundra region support a small, unique assemblage of freshwater fishes.

Wetlands are typical of the Arctic Tundra. Ecological reserves and wildlife refuges are found throughout the Arctic Tundra region. Disturbance caused by boats or aircraft usually is controlled by distance or altitude regulations in protected areas and advisory restrictions elsewhere. Sometimes boat activities, such as the use of horns, are restricted. Exhibit 3-12 gives distance/altitude restrictions currently in place in Arctic countries. Canada, Finland, Greenland, Russia, and the U.S. restrict the distance boats can approach breeding seabirds, but restrictions apply only to specific protected areas. Distance restrictions range from 15 meters (49 feet) for unmotorized boats in some reserves within Newfoundland, Canada, to 1,600 meters (5,250 feet) in reserves in the U.S.

Arctic countries restrict the altitude below which aircraft cannot fly over a seabird colony. In general, minimum altitudes are in the range of 300-500 meters (984 to 1,640 feet) but are higher over some reserves in the U.S. (700 meters [2,300 feet]). Canadian flight manuals advise a minimum altitude of over 600 meters (1,970 feet) when flying over bird concentrations. In Greenland, advisory rules are in place restricting disturbance to wildlife caused by mineral resource exploration and extraction (directed mainly at helicopters).

Exhibit 3-12. Regulated Activities Near Seabird Colonies in Arctic Regions

Country	Boat Distance (closest approach)	Boat Speed (maximum)	Aircraft Altitude (minimum)	Use of Boat Siren
Canada	20 meters (66 feet) – motorized[1] 15 meters (49 feet) – non-motorized 100 meters (328 feet) or 50 meters (164 feet) off murre colonies	--	300 meters (984 feet) April 1 – September 1 in Newfoundland province reserves, most large colonies are marked on aeronautical charts	Not explicitly restricted but not allowed if disturbance to colony occurs
Greenland	500 meters (1,640 feet) for some protected colonies	18 kilometers per hour (11 miles per hour)[2]	500 meters (1,640 feet)	--
U.S.	100 – 1,600 meters (328 – 5,250 feet)	--	500 – 700 meters (1,640 – 2,300 feet)	--

Source: Modified from Chardine and Mendenhall, 2003
[1]Provincial regulation; Gull Island, Witless Bay- mixed Atlantic Puffin, Black-legged Kittiwake, Common Murre colony. Boat tour operators presently exempt.
[2]Restriction in place for mineral exploration activities only

3.2.1.4 Geology and Soils

Under a protective layer of sod, water in the soil melts in summer to produce a thick mud that sometimes flows downslope to create bulges, terraces, and lobes on hillsides. The freeze and thaw of water in the soil sorts out coarse particles, giving rise to such patterns in the ground as rings, polygons, and stripes made of stones. The coastal plains have numerous lakes of thermokarst origin, formed by melting ground water.

Soil particles in the Arctic Tundra derive almost entirely from mechanical breakup of rock, with little or no chemical alteration. Continual freezing and thawing of the soil have disintegrated its particles. In the Arctic Tundra, the soil is very low in nutrients and minerals, except where animal droppings fertilize the soil. (Bailey, 1995) Below the soil is the tundra's permafrost, a permanently frozen layer of earth. The majority of the Arctic Tundra Biome resides on a layer of permafrost.

Geologic hazards in the Arctic Tundra Biome include earthquakes, volcanic activity, and avalanches.

3.2.1.5 Hazardous Materials and Hazardous Waste

Installations where MDA activities for the proposed BMDS may occur may store and use large quantities of hazardous materials, including a variety of flammable and combustible liquids. Procedures that comply with applicable laws and regulations for managing hazardous materials are developed to establish standard operating procedures for the correct management and storage of hazardous materials at installations. Due to the extreme climate, special measures may be necessary for storage and handling of hazardous materials in arctic areas.

Wastes generated by facilities that may be used for the proposed BMDS include oils, fuels, antifreeze, paint, paint thinner and remover, photo chemicals, pesticides, aerosol canisters, batteries, used acetone, sulfuric acid, and sewage sludge. Procedures that comply with applicable laws and regulations are developed for managing hazardous wastes at sites where activities for the proposed BMDS may occur.

3.2.1.6 Health and Safety

All activities associated with the proposed BMDS would comply with Federal, state, and local laws and regulations applicable to worker and environmental health and safety. The MDA would take every reasonable precaution during the planning and execution of the operations, training exercises, and test and development activities to prevent injury to human life or property. Health and safety procedures should be included in site-specific operating documents.

3.2.1.7 Noise

The principal sources of noise from missile defense operations are vehicular traffic and military activities, including aircraft operations, rocket testing, and rocket launches. Frequency and duration of noise from military activities vary as a factor of the irregular training schedules, and noise levels vary with the type of activities at these facilities. Sonic booms may be produced as a result of BMDS activities. Other sources of noise would result from construction activities. Measurements of ambient sound levels should be analyzed in site-specific environmental documents.

3.2.1.8 Transportation

Roadway travel in the Arctic Tundra Biome is generally limited due to the lack of roads in the vast, undeveloped terrain. The summer months experience the highest amount of traffic, due to tourism and good weather. The Arctic Tundra Biome includes railway systems that provide freight, passenger, and intermodal transportation across North America, as well as regional and local service railways. Given the vast area of the Arctic Tundra Biome and the limited road network, aircraft provide an alternate means of

transportation. Marine travel tends to be limited in the Arctic Tundra Biome due to glacial patches found throughout many waterways.

3.2.1.9 Water Resources

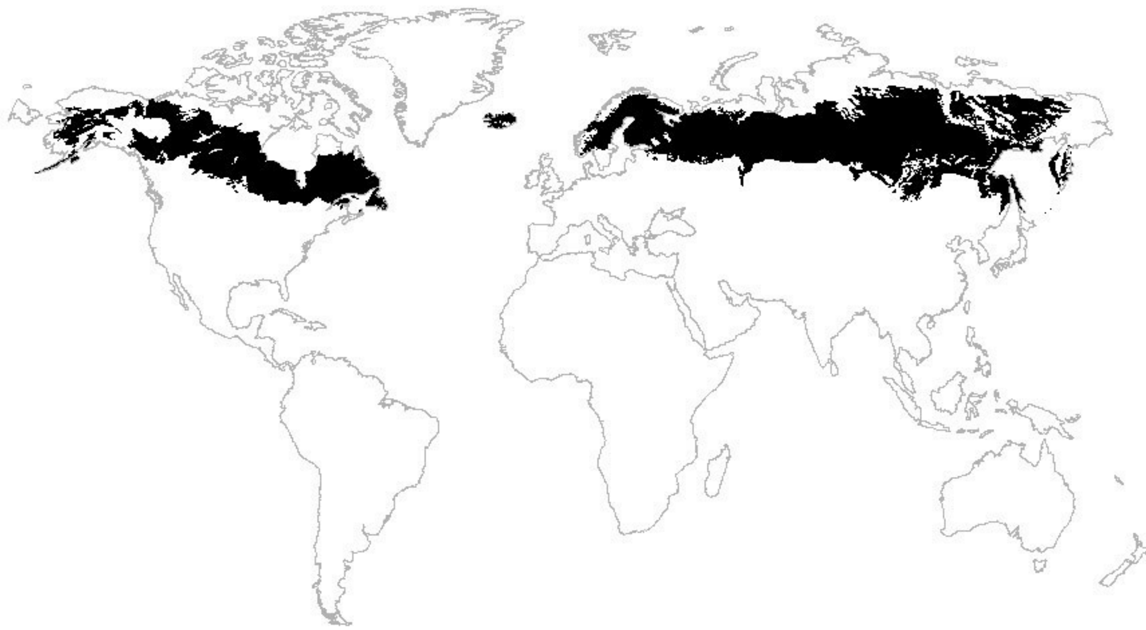
In the Arctic Tundra, alluvial deposits are the principal aquifers for ground water, which is greatly restricted by permafrost. During the summer when snow melts, the water percolates through the active layer but is unable to penetrate the permafrost. Pools of water form on the surface, and the active layer becomes saturated. Surface waters in the Arctic Tundra tend to be acidic and rich in organic material.

Surface water and ground water quality is generally good in the Arctic Tundra Biome except in isolated areas of known contamination. Although soils in the Arctic Tundra Biome are strongly acidic, pH of regional surface waters in North America is around 7, ranging from 6.8 to 7.5 in streams and 7.1 to 7.3 in lakes. The relatively high pH and capacity of streams and lakes to buffer acid inputs from natural and man-made sources are presumed to be the result of ions (e.g., calcium and magnesium) that have been carried into the atmosphere with sea spray and subsequently returned in rainfall. This is a common occurrence in coastal maritime regions. (Wetzel 1975, as referenced in FAA, 1996)

3.2.2 Sub-Arctic Taiga Biome

The Sub-Arctic Taiga Biome discussion focuses on the sub-arctic regions of North America, including portions of the state of Alaska. This biome is generally located between latitudes 50 and 60 degrees north (see Exhibit 3-13). The sub-arctic climate zone coincides with a great belt of needleleaf forest, often referred to as boreal forest, and with the open lichen woodland known as taiga. Existing inland sites found in Alaska in the Sub-Arctic Taiga Biome include Fort Greely (which includes Delta Junction), Clear Air Force Station, Eielson AFB, and Poker Flat Research Range.

Exhibit 3-13. Global Distribution of the Sub-Arctic Taiga Biome



Source: Modified From National Geographic, 2003b

Coastal sites also are located in the Sub-Arctic Taiga Biome, including portions of southwestern and western Alaska. Coastal sites are influenced by the cool climate generated by the cold waters of the North Atlantic Ocean and share maritime characteristics. Existing coastal sites where proposed BMDS activities may occur are found in Alaska in the Sub-Arctic Taiga Biome and include the KLC and the Port of Valdez.

3.2.2.1 Air Quality

The average temperature is below freezing for six months out of the year. Winter is the dominant season and the temperature range is -54°C to -1°C (-65°F to 30°F). Summers are mostly rainy, and humid, and temperatures range from –7°C to 21°C (20°F to 70°F). The total precipitation in a year is 30 to 85 centimeters (12 to 33 inches), which may fall as rain or snow or accumulate as dew. Surface winds along the coast are much stronger and more persistent than at inland areas.

Air quality in the Sub-Arctic Taiga Biome generally is considered favorable; however, some areas in and around urban centers, such as Anchorage and Fairbanks are in non-attainment for CO concentrations. These urban centers typically exceed CO NAAQS only during the winter (October through March).

Emissions from activities for the proposed BMDS include CO, NO_X, SO_X, VOCs, HAPs, and PM. In coastal areas, wind-blown volcanic dust is the primary air contaminant.

3.2.2.2 Airspace

Airspace above U.S. military airfields in the Sub-Arctic Taiga Biome generally includes controlled airspace and operates under IFR.

Much of Alaska's aviation activity takes place within existing MOAs, through a shared-use agreement, with information provided by the Special Use Airspace Information Service, which is a system operated by the U.S. Air Force under agreement with the FAA Alaskan Region to assist pilots with flight planning and situational awareness while operating in or around MOAs or Restricted Areas in interior Alaska.

There are approximately 600 civilian, military, and private airports and more than 3,000 airstrips in the state of Alaska. Existing military airfields, with runways that are paved and in good condition, would be used to support activities for the proposed BMDS.

Civilian aircraft generally fly along established flight corridors that operate under VFR.

3.2.2.3 Biological Resources

The vegetation of the Sub-Arctic Taiga Biome is primarily boreal forest, which is a complex array of plant communities shaped by fire, soil temperature, drainage, and exposure.

The interior areas of the Sub-Arctic Taiga Biome are populated with many animals that have evolved to meet conditions found at higher latitudes. All estuarine and marine areas out to the exclusive economic zone (322 kilometers [200 miles] from the coast) of the U.S. used by Alaskan Pacific salmon are designated as Essential Fish Habitat for salmon fisheries. Essential Fish Habitat also has been designated for scallops and Gulf of Alaska ground fish in the Port of Valdez. (U.S. Army Space and Missile Defense Command, 2003)

Most wetlands in the Sub-Arctic Taiga generally are classified as palustrine (non-flowing) or riverine, which occur alongside rivers and streams. On most wetlands in the sub-arctic region, wet soils result from a variety of sources, including the late melt of snow over either impervious subsoil layers such as glacial silts or discontinuous permafrost.

3.2.2.4 Geology and Soils

High mountains, broad lowlands, diverse streams and lakes, and complex rock formations characterize the geology of the Sub-Arctic Taiga Biome.

The boreal forest grows on poorly developed soils with pockets of wet, organic histosols. These light gray soils are wet, strongly leached, and acidic; they form a highly distinct layer beneath a topsoil layer of organic matter. Soils in the coastal areas are typically rocky, organic, or volcanic. The maritime taiga is characterized by poor drainage of surface water.

Geologic hazards in the Sub-Arctic Taiga Biome include earthquakes, volcanic activity, and avalanches.

3.2.2.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste in the Sub-Arctic Taiga Biome are similar to those found in the Arctic Tundra Biome described in Section 3.2.1.5.

3.2.2.6 Health and Safety

Health and Safety attributes of the Sub-Arctic Taiga Biome are similar to those discussed in Section 3.2.1.6.

3.2.2.7 Noise

The Sub-Arctic Taiga Biome generally is sparsely populated and most of the region is expected to have a background noise level of DNL less than or equal to 55 dBA.

3.2.2.8 Transportation

Transportation attributes of the Sub-Arctic Taiga Biome are similar to those discussed in Section 3.2.1.8.

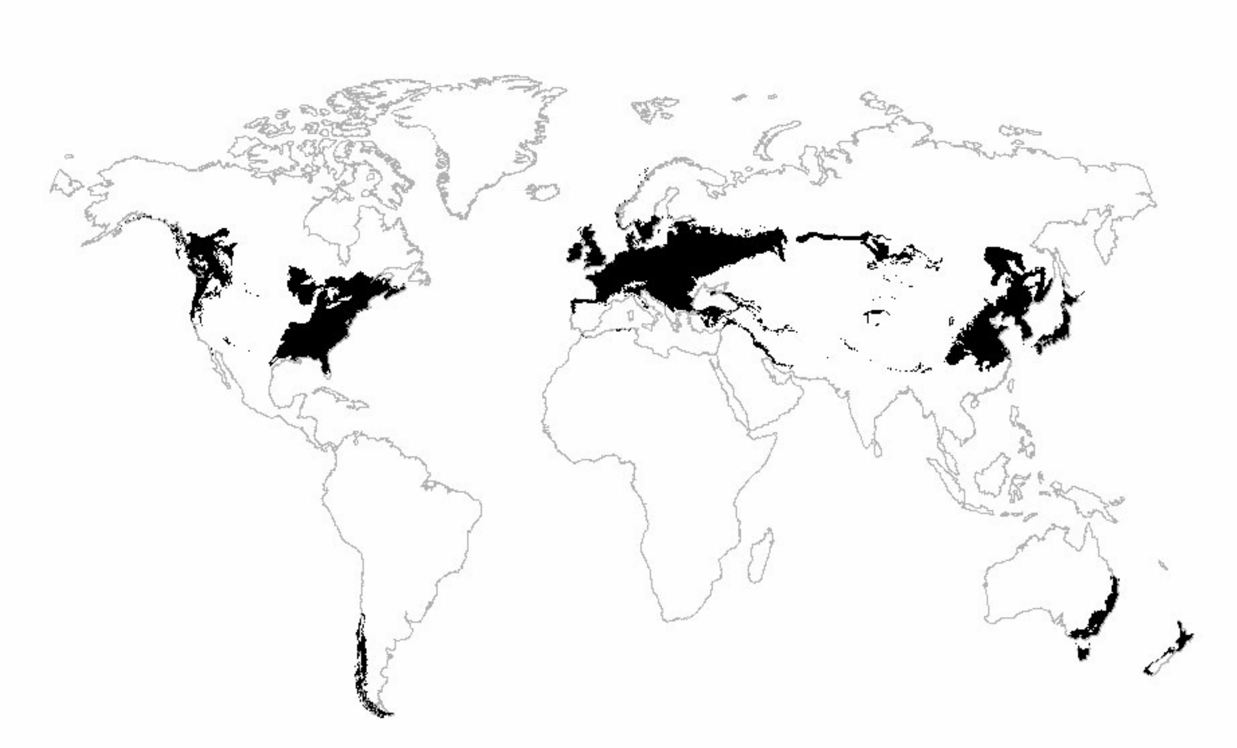
3.2.2.9 Water Resources

Ground water is supplied by rivers, precipitation, and melt water in the Sub-Arctic Taiga Biome. Characteristic of the taiga are innumerable water bodies, including bogs, fens, marshes, shallow lakes, rivers and wetlands, which are intermixed among the forest and hold vast amounts of water. In coastal areas, ground water is found primarily in river basins and recharged by infiltration of melt water from precipitation and glaciers. Water quality is subject to seasonal variations, but remains within established EPA drinking water standards.

3.2.3 Deciduous Forest Biome

As shown in Exhibit 3-14, the Deciduous Forest Biome includes the deciduous forest regions of North America, which include most of the eastern portion of the U.S. and parts of central Europe and East Asia. The description in this section of the U.S. deciduous forest is representative of this biome throughout the world.

Exhibit 3-14. Global Distribution of the Deciduous Forest Biome



Source: Modified From National Geographic, 2003b

Existing inland sites in the Deciduous Forest Biome include Redstone Arsenal, Alabama; Fort Devens, Massachusetts; and Aberdeen Proving Ground, Maryland.

Coastal sites also are located in the Deciduous Forest Biome. These sites share maritime characteristics. Existing coastal sites include Naval Air Station Patuxent River, Maryland; Wallops Island, Virginia; Cape Canaveral Air Force Station, Florida; Cape Cod Air Force Station, Massachusetts; and Eglin AFB, Florida.

3.2.3.1 Air Quality

The average annual temperature in a deciduous forest is 10°C (50°F). The average rainfall is 76 to 152 centimeters (30 to 60 inches) a year, with nearly 36 centimeters (14 inches) of rain in the winter and more than 46 centimeters (18 inches) of rain in the

summer. Humidity in these forests is high, ranging from 60 to 80 percent. Because of its location, air masses from both the cold polar region and the warm tropical region contribute to the climate changes in this biome.

Many metropolitan regions on the U.S. Atlantic Coast are in non-attainment for EPA's NAAQS for ozone, the primary constituent of urban smog. The southern Atlantic coast from Virginia through Florida is in attainment for all criteria air pollutants. However, the entire coastal area from northern Virginia through Maine is in non-attainment for ozone (ranging from moderate to severe), and small areas in Connecticut are in moderate non-attainment for PM_{10}.

Emissions from activities for the proposed BMDS include CO, NO_X, SO_X, VOCs, HAPs, and PM. Existing emissions sources in the coastal areas of the Deciduous Forest Biome are primarily the same as for those in the inland areas.

3.2.3.2 Airspace

The Deciduous Forest Biome in the U.S. contains all FAA classifications for airspace, as described in Section 3.1.2.

3.2.3.3 Biological Resources

On numerous sites where activities for the proposed BMDS may occur, native vegetation has been removed, and the land is landscaped and maintained by mowing and brush control measures. Isolated pockets of vegetation may remain on sites where activities for the proposed BMDS may occur, however, vegetation on off-site areas is widespread and may be undisturbed.

The Deciduous Forest Biome provides habitat for a wide variety of animals. State and federally endangered and threatened species in the biome include but are not limited to red-cockaded woodpeckers and the northeastern tiger beetle.

The Florida Keys have been designated a National Marine Sanctuary, Outstanding Florida Waters, and an Area of Critical State Concern. In addition, the Deciduous Forest Biome includes critical habitat. For example, critical habitat for the Northern Right whale (*Eubalaena glacialis*) is designated for portions of Cape Cod Bay and Stellwagen Bank, the Great South Channel (each off the coast of Massachusetts) and waters adjacent to the coasts of Georgia and the east coast of Florida.

3.2.3.4 Geology and Soils

The geology of the Deciduous Forest inland is varied and consists of low mountains and plateaus. The Coastal Plain is predominantly flat and is covered with terrestrial sediments.

There are two types of soil found in deciduous forests in the U.S. Fertile soils with high organic content are rich in nutrients and have well-developed layers of clay. The second type, the “red clay” soils are found in humid temperate and tropical areas of the world, typically on older, stable landscapes. In coastal areas of this biome, soils are predominantly deep and adequately drained.

Because limited seismic activity occurs along the Atlantic continental shelf, the risk of an earthquake in the Deciduous Forest Biome is low. Volcanic activity generally is not observed along the U.S. Atlantic and Gulf Coasts, however, cracks present in the Eastern Seaboard have the potential to cause the seabed to crumble and create a tsunami that would push huge masses of sea water toward the coast. Landslides are a significant geologic hazard throughout the Deciduous Forest Biome.

3.2.3.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste attributes of the Deciduous Forest Biome are similar to those discussed in Section 3.2.1.5. Except the moderate climate characteristic of the Deciduous Forest Biome does not require special consideration as is necessary in the extreme temperatures of the Arctic Tundra Biome.

3.2.3.6 Health and Safety

Health and Safety attributes of the Deciduous Forest Biome are similar to those discussed in Section 3.2.1.6.

3.2.3.7 Noise

The Eastern Range is a representative example of noise levels for sites where activities for the proposed BMDS may occur in the Deciduous Forest Biome. Ambient noise levels based on daytime monitoring, range from 60 dBA to 80 dBA. (DOT, 2001) Noise sources associated with the proposed BMDS are similar to those described in Section 3.2.1.7.

3.2.3.8 Transportation

The Deciduous Forest Biome includes both coastal and inland regions that sustain widespread infrastructure, including marine ports and docks that are supported by traffic

circulation systems such as highways and byways, unpaved roads, non-maintained roads, trails, railroad lines, municipal, private, and military airports and any other system involved in mass transportation.

On-site roadways provide access to launch complexes, support facilities, and industrial areas. Railways transport both cargo and passengers in the region.

There are numerous commercial, private, and military airports within the Deciduous Forest Biome. They vary in size from major international airports such as Hartsfield-Jackson Atlanta International Airport in Georgia that supports 80 million passengers each year to small, rural airstrips that support single engine planes.

The top ports in U.S. foreign trade are deep draft (drafts of at least 12 meters [40 feet]). Twenty-five U.S. ports, located within the Deciduous Forest Coastal Biome, received 73 percent of total vessel calls. (DOT BTS, 2001)

3.2.3.9 Water Resources

Ground water provides about 40 percent of the U.S. public water supply. Where water demand is great, sophisticated reservoir, pipeline, and purification systems are needed to meet demands. Ground water resources along the coast are vulnerable to saltwater intrusion and nutrient contamination. (USGS, 2000)

Water quality in the Deciduous Forest Biome varies depending on pressures from human activity (e.g., industrial effluents and agricultural run-off). Pollution of coastal waters often results from runoff laden with particulates and other pollutants; sewage treatment plants; combined sewer overflows; and storm drains that discharge liquid waste directly into the ocean through pipelines, dumping of materials dredged from the bottoms of rivers and harbors, and waste from fish processing plants, legal and illegal dumping of wastes from ships and ground water from coastal areas.

3.2.4 Chaparral Biome

The Chaparral Biome includes regions corresponding to those shown in Exhibit 3-15, but focuses on a portion of the California Coast and the coastal region of the Mediterranean from the Alps to the Sahara Desert and from the Atlantic Ocean to the Caspian Sea. Representative sites where activities for the proposed BMDS may occur are part of the Western Range, including Vandenberg AFB and the Point Mugu Sea Range.

Exhibit 3-15. Global Distribution of the Chaparral Biome

Source: Modified From National Geographic, 2003b

3.2.4.1 Air Quality

The Chaparral climate consists of hot summer drought and winter rain in the mid-latitudes, north of the subtropical climate zone. The climate in this area is unique with the wet season occurring in winter and annual rainfall of only 38 to 102 centimeters (15 to 40 inches). Cold ocean currents and fog affect temperatures, which limit the growing season. The high-pressure belts of the subtropics drift northwards in the Northern Hemisphere from May to August and they coincide with substantially higher temperatures and little rainfall. During the winter, weather becomes dominated by the rain-bearing low-pressure depressions. While usually mild, such areas can experience cold snaps when exposed to the icy winds of the large continental interiors, where temperatures can drop to -40°C (-40^{o}F) in the extreme continental climates. (Atmosphere, Climate and Environment Programme, 2003)

The primary sources of air pollutants in coastal areas include stationary sources, area sources, mobile sources, and biogenic sources such as forest fires. VOCs react with sunlight in the atmosphere to produce ozone (i.e., smog). In some areas, background levels of air pollutants are relatively high due to air currents depositing pollution from sources outside of the coastal area.

There is a large area along the Pacific coast, particularly in southern California that is in non-attainment for ozone (ranging from severe to extreme). A large area in southern California is in severe non-attainment for PM_{10}. (EPA, 2003f) The EPA has designated the near shore areas of southern California as unclassified/attainment areas. Due to the lack of major emissions sources in the area and the presence of strong northeast winds, the likelihood of pollutants remaining in the ambient air is low.

Heavy industrial activities, high automobile traffic, and energy generation are the main sources of air pollutants along the southern Pacific coast.

The European Union eight-hour air quality standard for ozone (53 nmol/mol) is exceeded throughout the summer in the entire Mediterranean region.

3.2.4.2 Airspace

Airspace in coastal regions of North America contains "North American Coastal Routes," which are numerically coded routes preplanned over existing airways and route systems to and from specific coastal fixes. See Section 3.1.2 for a description of North American Routes.

Portions of the Chaparral Biome are located in international airspace. Therefore, the procedures of the ICAO (outlined in ICAO Document 444, Rules of the Air and Air Traffic Services) are followed.

There are numerous restricted areas in the near shore environment associated with the Western Range. The procedures for scheduling each portion of airspace are performed in accordance with letters of agreement with the controlling FAA facility, Los Angeles Air Route Traffic Control Center (ARTCC).

Numerous airports and airfields exist within the Chaparral Biome. Numerous jet routes that cross the Pacific pass through the U.S. Chaparral Biome, including A331, A332, A450, R463, R465, R584, Corridor V506 and Corridor G10.

3.2.4.3 Biological Resources

The vegetation of the Chaparral is characterized by the presence of hard, tough, evergreen leaves and low, shrubby appearance.

Birds of the Chaparral include the endangered California gnatcatcher (*Polioptila californica*), California thrasher (*Toxostoma redivivum*), western scrub jay (*Aphelocoma californica*), and cactus wren (*Campylorhynchus brunneicapillus*).

The near shore and coastal environment of the Chaparral Biome support numerous threatened or endangered species.

The Chaparral Biomes around the world support 20 percent of all plants, but these areas are all relatively small and many are threatened. Essential Fish Habitat includes those waters and sediment that are necessary to complete the life cycle for fish from spawning to maturity. There are two Essential Fish Habitat zones in this region, coastal pelagic and groundfish.

3.2.4.4 Geology and Soils

The California Coastal Chaparral area consists of narrow ranges with wide plains in between, as well as alluviated lowlands and coastal terraces.

The soils of the Chaparral Biome may be classified into four categories, coastal beach sands, tidal flats, loamy sands, and silty clay. The erosion hazard of these soils depends on slope and vegetation cover.

The California Chaparral Coastal area is noted for its intense seismic activity due to the right lateral motion of the Pacific and North Atlantic Plate boundary.

3.2.4.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste attributes of the Chaparral Biome are similar to those discussed in Section 3.2.1.5. Except the moderate climate characteristic of the Chaparral Biome does not require special consideration as is necessary in the extreme temperatures of the Arctic Tundra Biome.

3.2.4.6 Health and Safety

Health and Safety attributes of the Chaparral Biome are similar to those discussed in Section 3.2.1.6.

3.2.4.7 Noise

Vandenberg AFB is a representative example of noise levels for sites where activities for the proposed BMDS may occur in the Chaparral Biome. Ambient noise levels at Vandenberg AFB range from 48 dBA to 67 dBA. (DOT, 2001) Noise sources associated with the proposed BMDS are described in Section 3.2.1.7.

3.2.4.8 Transportation

Transportation attributes of the Chaparral Biome are similar to those discussed in Section 3.2.3.8.

3.2.4.9 Water Resources

Very few perennial streams occur in the Southern California coastal area. There is relative scarcity, on a per capita basis, of freshwater supplies in Mediterranean regions, where agriculture competes for freshwater with growing tourism and industrial use. (UNEP Plan Bleu, 2000)

Water quality attributes of the Chaparral Biome are similar to those described in Section 3.2.3.9.

3.2.5 Grasslands Biome

As shown in Exhibit 3-16, the Grasslands Biome includes the grasslands of North and South America, Eurasia, and Australia. The description in this section is representative of this biome throughout the world. Currently there are no active sites in the Grassland Biome where activities for the BMDS are proposed to occur. However, past military installations within this biome make it reasonable foreseeable that future activity proposed for the BMDS could occur there. There are no reasonably foreseeable coastal sites located in the Grasslands Biome.

Exhibit 3-16. Global Distribution of the Grasslands Biome

Source: Modified From National Geographic, 2003b

3.2.5.1 Air Quality

In the Grasslands Biome, approximately 25 to 76 centimeters (10 to 30 inches) of precipitation falls annually. The temperature varies due to the vast latitudinal span of the grasslands, with annual temperatures ranging from -20ºC to 43°C (-4ºF to 104°F). The average annual temperature across the Grasslands Biome is 24°C (43°F). The low humidity of the Grasslands Biome arises because mountain barriers block warm, moist air from oceans.

Air pollution issues of special concern to the Grasslands Biome are emissions from open burning and fugitive dust.

Due to the low population density of most grassland areas, biogenic (naturally occurring) activities are the predominant sources of air pollution emissions in this biome.

3.2.5.2 Airspace

The U.S. Grassland Biome contains all FAA airspace classifications, as described in Section 3.1.2.

3.2.5.3 Biological Resources

Short grasses, which are predominant throughout the Grasslands Biome, have adapted physiological responses to widespread drought and fire.

Naturally occurring grasslands are becoming harder to find due to human encroachment that can be attributed to increasing population pressures, desire for farmland, and oil exploration, among others. Biological resources of particular concern in the biome are migrating waterfowl and ephemeral prairie potholes.

3.2.5.4 Geology and Soils

The predominant soil type found throughout the Grasslands Biome is characterized by a thick, dark surface horizon resulting from the long-term addition of organic matter derived from plant roots.

There are no significant geological hazards within the Grasslands Biome.

3.2.5.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste attributes of the Grasslands Biome are similar to those discussed in Section 3.2.1.5, except that the moderate climate characteristic of

the Grassland Biome does not require special consideration as is necessary in the extreme temperatures of the Arctic Tundra Biome.

3.2.5.6 Health and Safety

Health and Safety attributes of the Grasslands Biome are similar to those discussed in Section 3.2.1.6.

3.2.5.7 Noise

Noise sources associated with the proposed BMDS are similar to those described in Section 3.2.1.7.

3.2.5.8 Transportation

Railroads and motor carriage (i.e., trucking) are the backbone of the freight transportation system in the Grasslands region. The highway system in the prairies consists largely of rural roads, many of which are local roads that are maintained by county and township governments.

3.2.5.9 Water Resources

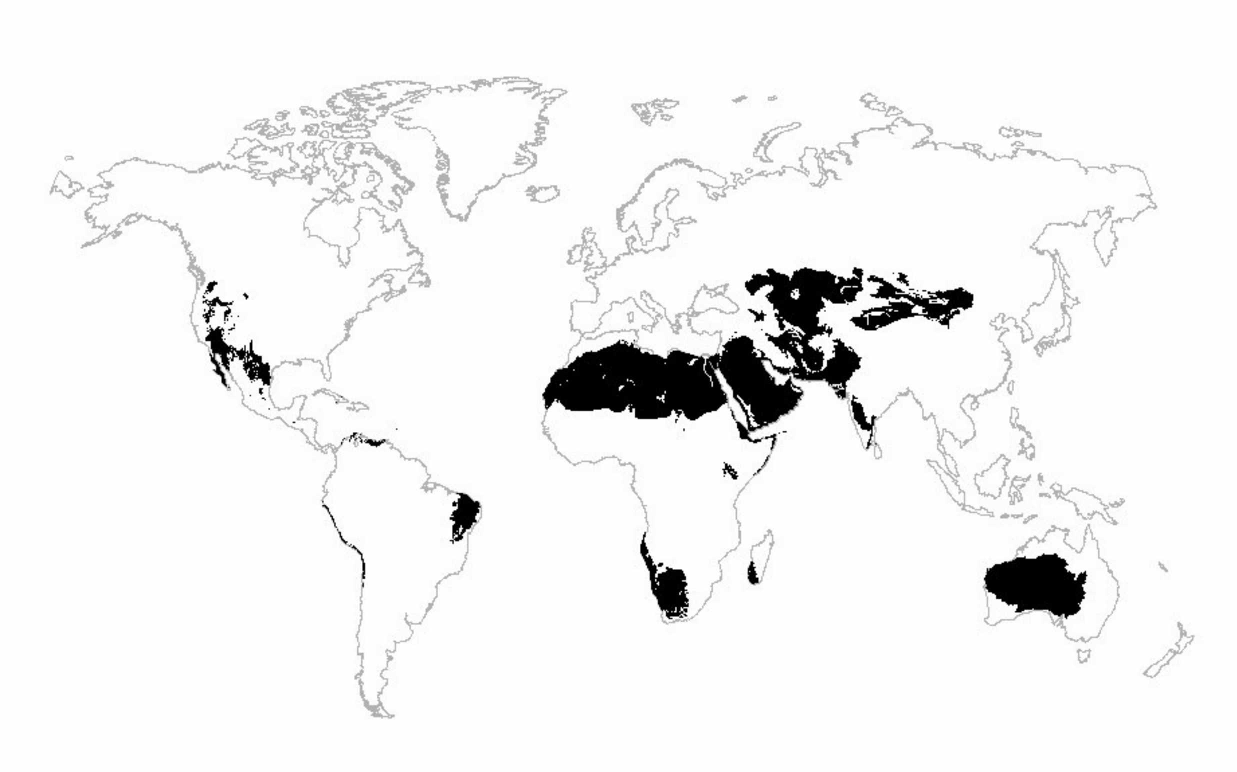
Sources of water in the Grasslands Biome include precipitation, ground water in aquifers, and surface water in rivers, streams, lakes, and wetlands. Due to the heavy dependence on underground water systems for irrigation of the plains' extensive farmland (and to a lesser extent for municipal water systems and industrial development), the depletion of the Grassland Biome's aquifers is of special concern.

The quality of water in the High Plains aquifer generally is suitable for irrigation use, but in many places, the water does not meet EPA drinking water standards with respect to several dissolved constituents: dissolved solids/salinity, fluoride, chloride, and sulfate. (USGS, 2003)

3.2.6 Desert Biome

The Desert Biome includes the desert regions of North America, which include the western arid environment of the southwestern U.S. (See Exhibit 3-17) The description in this section of the U.S. desert is representative of this biome throughout the world. Existing inland sites in the Desert Biome include WSMR, New Mexico; Fort Bliss, Texas; Edwards AFB, California; and the Nevada Test Site, Nevada.

Exhibit 3-17. Global Distribution of the Desert Biome



Source: Modified From National Geographic, 2003b

3.2.6.1 Air Quality

In cold desert regions, temperatures range from 2ºC to 4ºC (36ºF to 39ºF) in the winter and from 21ºC to 26ºC (70ºF to 79ºF) in the summer. Total annual precipitation averages 15 to 26 centimeters (six to ten inches). In contrast, hot desert regions have average monthly temperatures above 18ºC (64ºF), with typical temperatures ranging from 20^{o}C to 25ºC (68^{o}F to 77ºF). Hot desert regions usually have very little precipitation annually and/or concentrated precipitation in short periods, totaling less than 15 centimeters (six inches) per year.

A unique pollutant of concern in desert regions is dust, i.e., PM, which contributes to desertification, the process of creating deserts. Activities that expose and disrupt topsoil, such as grazing and agricultural cultivation common throughout the western U.S., can increase the amount of dust released into the air.

The predominant source of air pollution in the Desert Biome is agriculture, which disturbs the surface layer soil and emits dust into the air.

3.2.6.2 Airspace

The U.S. Desert Biome contains all FAA classifications for airspace, as described in Section 3.1.2.

3.2.6.3 Biological Resources

The Desert Biome encompasses three major vegetation types: semi-desert grassland, plains-mesa sand scrub, and desert scrub.

Desert animals include small nocturnal carnivores, insects, arachnids, reptiles, and birds.

3.2.6.4 Geology and Soils

Nearly 50 percent of desert surfaces are plains where the removal of fine-grained material by wind has exposed loose gravels consisting predominantly of pebbles and occasional cobbles, forming "desert pavement." The remaining surfaces of the Desert Biome are composed of exposed bedrock outcrops, desert soils, and fluvial deposits, including alluvial fans (a cone-shaped deposit of sediments), playas (dry lake beds), desert lakes, and oases. Bedrock outcrops commonly occur as small mountains surrounded by extensive erosional plains.

Desert soils are predominately mineral soils with low organic content. Poorly drained areas may develop saline soils and dry lakebeds may be covered with salt deposits. Geologic hazards within the Desert Biome include earthquakes and landslides.

3.2.6.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste attributes of the Desert Biome are similar to those discussed in Section 3.2.1.5.

3.2.6.6 Health and Safety

Health and Safety attributes of the Desert Biome are similar to those discussed in Section 3.2.1.6.

3.2.6.7 Noise

Ambient noise levels for remote desert environments range from 22 to 38 dBA. Ambient noise levels at a representative site where activities for the proposed BMDS may occur within the Desert Biome range from 65 dBA to 85 dBA at Edwards AFB and from 45 dBA to 65 dBA at WSMR. (DOT, 2001) Noise sources associated with the proposed BMDS are described in Section 3.2.1.7.

3.2.6.8 Transportation

Because the population density is so low and dispersed throughout most of the region, transportation infrastructure is concentrated near metropolitan centers.

3.2.6.9 Water Resources

In the Desert Biome, droughts and aquifer supply issues are of particular concern. The leading causes of impairment of rivers and streams include pathogens (bacteria), siltation (sedimentation), and habitat alterations, and the leading sources for these include agriculture, hydraulic modifications, and habitat modifications.

3.2.7 Tropical Biome

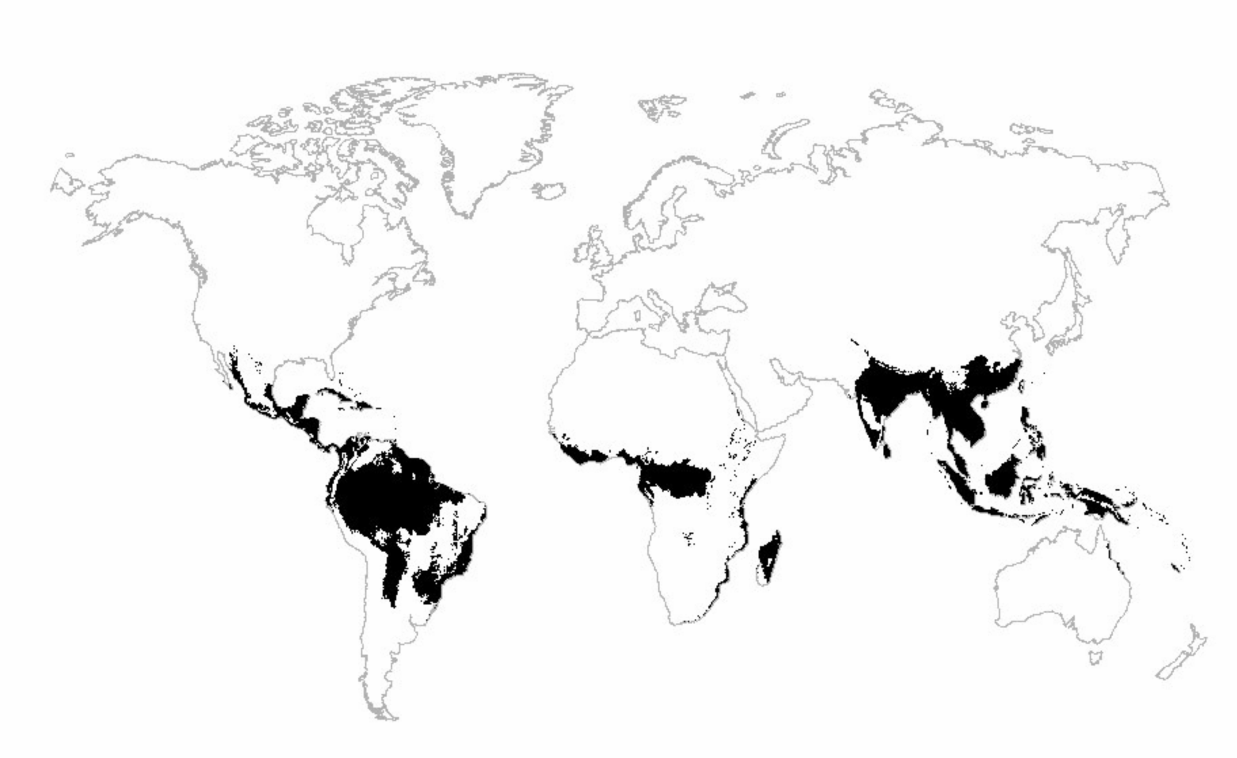
The Tropical Biome[49] encompasses areas within the Pacific and Atlantic Oceans. (See Exhibit 3-18) The coastal zone stretches 1,000 meters (3,281 feet) inland of the coastal shoreline, tidal wetlands, coastal wetlands, and coastal estuaries. (Coastal Planning Coalition of Australia, 2003) Because many of the islands within the Pacific and Atlantic Oceans are relatively small, the entire island may be considered within this Affected Environment section.

The Pacific Tropical Biome would include islands found within the equatorial region. The Pacific contains approximately 25,000 islands, the majority of which are found south of the equator. (Wikipedia, 2003) Current Ranges within this biome where activities of the proposed BMDS may occur include PMRF, U.S. Army Kwajalein Atoll (USAKA), Wake Island, and Midway.

The majority of islands in the Atlantic Tropical Biome are in the Caribbean between the Caribbean Sea and the North Atlantic Ocean.

[49] Exhibit 3-18 shows the global location of the Tropical ecosystem. However, based on reasonably foreseeable locations for activities for the proposed BMDS to occur, the affected environment focuses on the coastal portions of this ecosystem.

Exhibit 3-18. Global Distribution of the Tropical Biome



Source: Modified From National Geographic, 2003b

3.2.7.1 Air Quality

The climate for the Tropical Biome is tropical marine to semi-tropical marine, characterized by relatively high annual rainfall and warm to hot, humid weather throughout the year. Steadily blowing trade winds allow for relatively constant temperatures of 21°C to 27°C (70°F to 81°F) throughout the year. The annual rainfall in the Tropical Biome is approximately 127 to 1,016 centimeters (50 to 400 inches).

Ambient air quality monitoring data are not readily available for islands in the Pacific. In the Caribbean, and Latin America generally, increasing urbanization and rampant forest destruction have led to considerable air quality degradation.

Because of the relatively small numbers and types of air pollution sources, dispersion caused by trade winds, and lack of topographic features at most locations, air quality in the equatorial region is considered good (i.e., well below the maximum pollution levels established for air quality in the U.S.). (U.S. Army Space and Missile Defense Command, 2003)

3.2.7.2 Airspace

The majority of islands in the Pacific Tropical Coastal region are located in international airspace and therefore, the procedures of the ICAO are followed. The Atlantic Pacific Coastal region consists of both U.S. and international airspace.

The procedures for scheduling each portion of airspace are performed in accordance with letters of agreement with the controlling FAA facility.

There are numerous Range-affiliated airport and airfields located within the Pacific Tropical Coastal Affected Environment, including Wake Island, USAKA, PMRF, and Midway. Many of these airfields are engaged in activities similar to those of the proposed activities. Future test events would act in accordance with existing activities at the airfields. The majority of local airports within the Atlantic Tropical Coastal region handle smaller, private aircraft, which are uncontrolled.

High-altitude overseas jet routes cross the Pacific Tropical Coastal region via nine Control Area Extension corridors off the California coast.

3.2.7.3 Biological Resources

Vegetation and wildlife in the Tropical Biome is among the most biologically diverse in the world.

There are numerous environmentally sensitive habitats within the Tropical Biome, including barrier reefs, whale sanctuaries, and fisheries.

3.2.7.4 Geology and Soils

Islands within the Pacific Tropical Biome range from atolls with small, low inlets and extensive lagoons, to raised limestone islands, to volcanic high islands with substantial topographic and internal climatic diversity. Coral reefs have developed upon the eroded platforms around some of the islands.

Islands within the Atlantic Tropical Biome are composed of two distinctive chains of islands, the Lesser and Greater Antilles. The islands are characterized by a range of geological formations, from volcanic and sedimentary strata to coral limestone and alluvium.

The soils on smaller atolls in the Pacific Ocean have low fertility due to alkalinity. The soils are permeable, and infiltration is rapid. Wind erosion is severe when vegetation has been removed.

The islands within the Atlantic Tropical Biome include a wide range of soils, which may be derived from limestone, serpentine, dolomite, basalt, granite, diorite, gabbro, sandstone, or slate.

Volcanic islands within the Pacific Ocean have been built of successive lava flows. Volcano eruptions occur relatively frequently on the islands. (NOAA, 2003b)

In the Atlantic region, many earthquakes and tsunamis have occurred in the northeastern Caribbean, where the movements of the Earth's surface plates are rapid and complicated. (USGS, 2001) Volcanoes erupt on the eastern and western sides of the Caribbean plate.

3.2.7.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste attributes of the Tropical Biome are similar to those discussed in Section 3.2.1.5. However, the moderate climate characteristic of the Desert Biome does not require consideration as is necessary in the extreme temperature of the Arctic Tundra Biome.

3.2.7.6 Health and Safety

Health and Safety attributes of the Tropical Biome are similar to those discussed in Section 3.2.1.6.

3.2.7.7 Noise

Natural background sound levels in the Tropical Biome are relatively high due to wind and surf. Sources of noise in the Tropical Biome are similar to principle sources of noise associated with sites where activities for the proposed BMDS may occur, as described in the Section 3.2.1.7.

3.2.7.8 Transportation

The smaller islands may require marine transport vessels to transport passengers and supplies between islands. The isolated locations of the equatorial environments make transportation vital to many of the locations. Ground transportation facilities consist of roadways and pathways used by motor vehicles, bicycles, and pedestrians. Ships and smaller craft carry ocean cargo and fuel to the Equatorial Islands and deliver workers and cargo, including fuel, between islands.

3.2.7.9 Water Resources

Seasonal rainfall is the primary source of freshwater for most small islands. Catchments are used to capture rainfall for potable use. Raw water is stored in aboveground storage

tanks. Coastal areas of the Caribbean near major watersheds often contain large lagoons of fresh or brackish water.

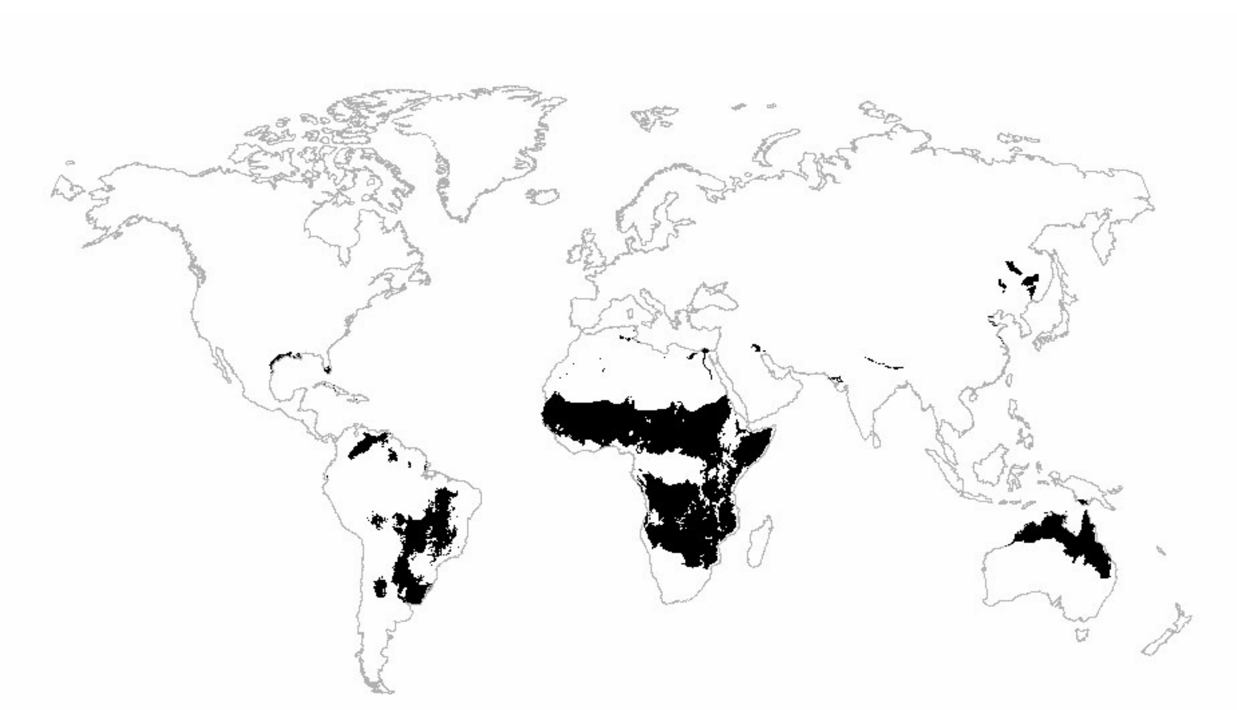
Of the land-based sources of pollution, eutrophication, or nutrient enrichment, from human sewage disposal is a growing problem in the Caribbean, particularly in the vicinity of large coastal cities and harbors.

Pacific Island water quality is generally of very high, with high dissolved oxygen and pH at levels typical of mid-oceanic conditions.

3.2.8 Savanna Biome

The Savanna Biome includes the transitional zone between the tropical forest and the semi-desert scrub vegetation types and typically occupies latitudes between 5º and 20º North and South of the equator (see Exhibit 3-19). Savannas cover extensive areas in the tropics and subtropics of Central and South America, Central and South Africa, and northern Australia in both inland and coastal environments. Currently there are not sites in the Savanna Biome where activities are proposed for the BMDS; however, it is reasonably foreseeable that future activity for the BMDS could occur here. The description in this section is representative of this biome throughout the world.

Exhibit 3-19. Global Distribution of the Savanna Biome



Source: Modified From National Geographic, 2003b

3.2.8.1 Air Quality

Towards the equator, annual rainfall is typically higher relative to the more poleward edges of the Savanna belt, and total annual precipitation may be as high as 250 centimeters (98 inches). On the Savanna edges nearest the tropics (towards the poles), annual rainfall totals may be as little as 50 centimeters (20 inches). In Australian savanna environments, coastal areas receive twice as much rainfall as inland savannas.

Annual temperatures in the Savanna Biome are relatively constant, averaging roughly 24ºC to 27ºC (75ºF to 80ºF).

The Savanna Biome faces similar air quality concerns as those found in the Grassland Biome, namely emissions from open burning, natural drought-driven fires, and other fugitive dust.

Fire is a predominant emission source, while anthropogenic activities, such as agriculture and mining also contribute.

3.2.8.2 Airspace

The Savanna Biome is located in international airspace; and therefore, the procedures of the ICAO are followed.

3.2.8.3 Biological Resources

Savannas are characterized by a continuous cover of perennial grasses, often one to two meters (three to six feet) tall at maturity. They also may have an open canopy of drought- or fire-resistant trees or an open shrub layer.

National parks and reserves have been established to preserve and protect threatened vegetative and wildlife species in the Savanna Biome. However, the parks are vastly under funded and often poorly managed.

3.2.8.4 Geology and Soils

Savannas typically have porous (often sandy) soil, with only a thin covering of nutrient-rich humus and an overall low concentration of nutrients.

Savannas are similar to grasslands in geologic and topographic features, predominantly characterized by flat terrain and may be marked with escarpments and other plateau-like features of sandstone or limestone composition. There are no significant geological hazards throughout the Savanna Biome.

3.2.8.5 Hazardous Materials and Hazardous Waste

There are no existing facilities proposed for use in the BMDS in the Savanna Biome. However, future sites would use hazardous materials similar to those in use at existing sites discussed in this chapter and would produce similar hazardous wastes.

Any future facilities that may be used as part of the proposed BMDS would adhere to all applicable legal requirements for hazardous materials and hazardous waste management as described in Section 3.1.7.

3.2.8.6 Health and Safety

Health and safety attributes of the Savanna Biome are similar to those discussed in Section 3.2.1.6.

3.2.8.7 Noise

Noise sources associated with the proposed BMDS in the Savanna Biome are similar to those described in Section 3.2.1.7.

3.2.8.8 Transportation

Transportation in the Savanna Biome is typically limited due to the frequently remote and rural nature of savannas. Highways, if present, are typically unpaved and may not be regularly maintained due to the low volume of traffic carried and remote locations. Railways are not a dominant form of transportation in the Savanna Biome.

Airports with paved runaways are scarce in the Savanna Biome.

Navigable waterways are present in some wetter savannas and may be used to transport goods to ports along coastal savannas.

3.2.8.9 Water Resources

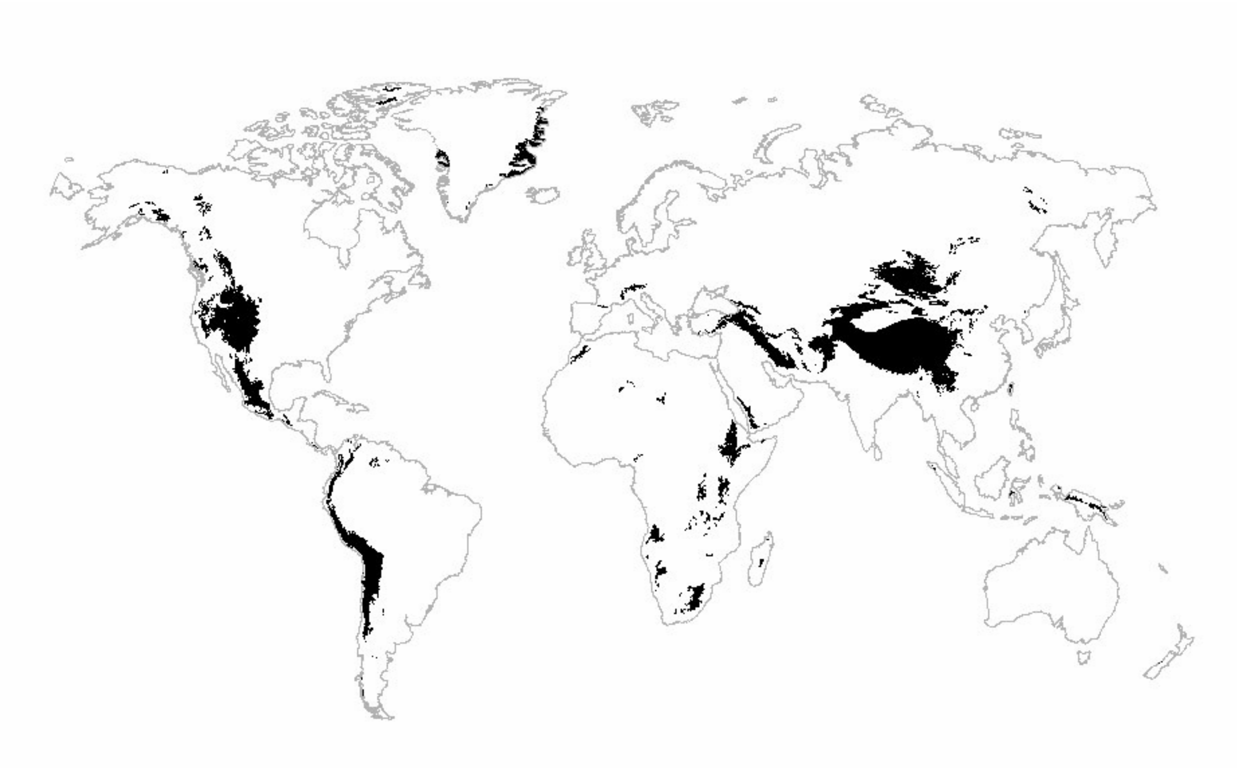
Savanna water resources are highly vulnerable to the effects of weed invasion, feral animals, overgrazing, and fire. Water resources are further strained by heavy water use in riparian areas for agriculture and tourism. (Douglas and Lukacs, 2004)

Water quality problems most commonly are caused by livestock and feral animals during the dry season.

3.2.9 Mountain Biome

As shown in Exhibit 3-20, the Mountain Biome includes the mountainous regions of North America and Europe, which include the Rocky Mountains in the western U.S. and the Alps in central Europe. The description in this section is representative of this biome throughout the world. Mountain Biomes are found at high altitudes and lie just below and above the snow line of a mountain. Existing inland sites in the Mountain Biome include Buckley AFB, Cheyenne Mountain AFB and Fort Carson Military Reserve, Colorado; and F.E. Warren AFB, Wyoming.

Exhibit 3-20. Global Distribution of the Mountain Biome



Source: Modified From National Geographic, 2003b

3.2.9.1 Air Quality

Given its high altitude, the Mountain Biome is characteristically cold with heavy snowfall and frequently bitter winds. Temperatures remain below freezing for at least seven months of the year, and in the summer, average temperatures range from 10°C to 15°C (50°F to 59°F). The average precipitation across mountain environments is 30 centimeters (12 inches) a year.

Mountain Biomes exhibit particular sensitivity to air pollution via deposition of both wet and dry pollutants, principally in snowpacks, which can in turn result in reduced surface water quality. Regional air pollutants of concern to mountainous areas include visibility-reducing PM, deposition of nitrogen and sulfur compounds, ozone, greenhouse gases that contribute to localized warming, and air toxics such as mercury and persistent organic pollutants.

Typical sources of air pollutants in the Mountain Biome include population centers, energy development and power plants, and agricultural activities.

3.2.9.2 Airspace

The U.S. Mountain Biome contains all FAA classifications for airspace, as described in Section 3.1.2.

3.2.9.3 Biological Resources

The high elevations of the mountain environments have harsh climatic conditions that support about 200 species of mountain plants.

Mountain animals have to tolerate cold temperatures and intense ultraviolet radiation. Because of the year-round cold, only warm-blooded animals can survive in the Mountain Biome, although insects also exist.

Some mammals within the Mountain Biome are considered sensitive species and may warrant special conservation measures, including critical habitat designation. Because food chains may be shorter in this biome than in more temperate biomes, food chains are more sensitive to environmental changes.

3.2.9.4 Geology and Soils

Much of the Mountain Biome appears as barren rock or a cover of thin soils. Soils in the biome are relatively fragile and are subject to erosion when disturbed.

The Mountain Biome is a complex network of mountain ranges characterized by extreme physiographic variability. Wide differences in elevation, slope steepness, and exposure exist locally and between major mountain masses.

Mountain Biomes are subject to numerous geological hazards, including earthquakes, landslides, and volcanoes.

3.2.9.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste attributes of the Mountain Biome are similar to those discussed in Section 3.2.1.5.

3.2.9.6 Health and Safety

Health and Safety attributes of the Mountain Biome are similar to those discussed in Section 3.2.1.6.

3.2.9.7 Noise

Sources of noise in the Mountain Biome are similar to principle sources of noise associated with sites where activities for the proposed BMDS may occur, as described in Section 3.2.1.7.

3.2.9.8 Transportation

The Mountain Biome sustains widespread infrastructure, including traffic circulation systems such as highways and byways, unpaved roads, non-maintained roads, trails, railroad lines, municipal, private, and military airports and any other system involved in mass transportation.

Due to the extreme cold and heavy snowfall characteristic of the Mountain Biome, airports within this region require the ability to provide landing access under zero visibility conditions such as blizzards and de-icing capability.

3.2.9.9 Water Resources

Surface water resources in the Mountain Biome include glacial lakes, streams, and rivers fed by rainfall and melting snow and those that originate from ground water sources. Mountain lakes are particularly sensitive to the effects of acidification because they have soft water, which does not neutralize acid readily.

In the Mountain Biome, elevated levels of contaminants accumulate in snowpacks, negatively impacting local flora and fauna. Upon melting, the concentrated pollutants are dispersed throughout the area watershed, deteriorating the quality of downstream surface and ground water systems. (USGS, 2003)

3.2.10 Broad Ocean Area

For purposes of this PEIS, the BOA encompasses the Pacific Ocean, the Atlantic Ocean, and the Indian Ocean.

Proposed activities in the BOA would take place at a distance of several hundred kilometers from any land mass. The BOA is subject to EO 12114, *Environmental Effects Abroad of Major Federal Actions,* which requires consideration of Federal actions abroad with the potential for impacts to the environment.

The Pacific Ocean is comprised of approximately 156 million square kilometers (60 million square miles) and includes the Bali Sea, Bering Sea, Bering Strait, Coral Sea, East China Sea, Flores Sea, Gulf of Alaska, Gulf of Tonkin, Java Sea, Philippine Sea, Savu Sea, Sea of Japan, Sea of Okhotsk, South China Sea, Tasman Sea, Timor Sea, and other tributary water bodies. Its maximum length is 14,500 kilometers (9,000 miles) and its greatest width is 17,700 kilometers (11,000 miles), which lies between the Isthmus of Panama and the Malay Peninsula. (Encyclopedia.com, 2003)

The Atlantic Ocean is comprised of approximately 76.8 million square kilometers (29.6 million square miles) and includes the Baltic Sea, Black Sea, Caribbean Sea, Davis Strait, Denmark Strait, part of the Drake Passage, Gulf of Mexico, Mediterranean Sea, North Sea, Norwegian Sea, almost all of the Scotia Sea, and other tributary water bodies. The Atlantic Ocean extends from the North Pole southward for about 16,100 kilometers (10,000 miles) to the Antarctic continent, and covers 106 million square kilometers (41 million square miles). The width of the Atlantic varies from approximately 2,850 kilometers (1,770 miles) between Brazil and Liberia to 4,830 kilometers (3,000 miles) between Norfolk, VA, and Gibraltar. The average depth is about 3,660 meters (12,000 feet) and the greatest depth is 8,650 meters (28,400 feet) in the Puerto Rico Trench. (Oceans of the World, 2003)

The Indian Ocean is comprised of about 68 million square kilometers (26 million square miles) and includes the Andaman Sea, Arabian Sea, Bay of Bengal, Great Australian Bight, Gulf of Aden, Gulf of Oman, Mozambique Channel, Persian Gulf, Red Sea, Strait of Malacca, Timor Sea, and other tributary water bodies. (CIA, 2003) It is triangular and bordered by Africa, Asia, Australia, and the Southern Ocean. Its maximum width is about 10,000 kilometers (6,200 miles) between the southernmost portions of Africa and Australia, and its average depth is approximately 4,000 meters (13,120 feet). The greatest depth occurs in the Java Trench at approximately 7,300 meters (24,000 feet) below sea level. (Oceans of the World, 2003)

3.2.10.1 Air Quality

No sources of ambient air quality monitoring data are known to exist for the BOA. There are no known existing emission sources in the Pacific Ocean. Air quality over the Pacific Ocean is expected to be good because there are no major sources of air pollution, and the nearly constant trade winds in the area serve to disperse any pollutants from transient sources, such as passing seagoing vessels or low-flying aircraft.

In the Atlantic Ocean, there is potential for large, thick plumes of aerosols blowing eastward over the North Atlantic. The aerosol plume is the regional haze produced by the industrial northeastern U.S. and typically occurs during the summer months. The haze is composed of sulfates and organics that originate from power plants and automotive sources. (NASA, 2003a) Ozone and other pollutants found in the Atlantic Ocean are primarily the result of anthropogenic sources.

A monitoring station in the Maldives Islands records air quality in the Indian Ocean. (Environmental News Network, 1999) The aerosol cloud covering much of the northern Indian Ocean originates primarily (at least 85 percent) from anthropogenic sources (Max Planck Society, 2001), namely agricultural and other biomass burning, the use of biofuels, and fossil fuel combustion in South and Southeast Asia. (Lelieveld et al., 2001) Model calculations indicate that, in contrast to European and North American pollution, anthropogenic emissions from South and East Asia reduce the concentration of hydroxyl (OH) radicals. Because OH is a powerful oxidant and acts as an atmospheric cleansing agent, the Asian pollution decreases the oxidizing power of the atmosphere, contributing to greater pollution problems over the Indian Ocean. (Max Planck Society, 2001)

Air quality over the Indian Ocean is seasonally poor due to anthropogenic emissions from growing South and Southeast Asian countries, particularly India. During the dry monsoon season (northern hemisphere winter), air pollutants in South and Southeast Asia are transported long distances to the Indian Ocean by persistent northeasterly monsoon winds. A dense, brown haze covers an area greater than 10 million square kilometers (3,900 million square miles) over most of the northern Indian Ocean (Max Planck Society, 2001), including the Arabian Sea, much of the Bay of Bengal, and part of the equatorial Indian Ocean to about five degrees south of the equator. (Environmental News Network, 1999) The haze extends from the ocean surface up to three kilometers (two miles). Comprised primarily of soot, sulfates, nitrates, organic particles, fly ash, and mineral dust, the airborne particles can reduce visibility over the BOA to less that 10 kilometers (6.2 miles) and reduce the solar heating of the ocean by about 15 percent. The haze also contains relatively high concentration of gases, including CO, SO_2, and other organic compounds. (Environmental News Network, 1999)

3.2.10.2 Airspace

Because the airspace in the BOA is beyond the territorial limit and is in international airspace, the procedures of the ICAO, outlined in ICAO Document 444, *Rules of the Air and Air Traffic Services* are followed. The FAA acts as the U.S. agent for aeronautical information to the ICAO.

Domestic Warning Areas are established in international airspace to contain activity that may be hazardous and to alert pilots of nonparticipating aircraft to the potential danger.

There are no airports or airfields located in the BOA.

High-altitude overseas jet routes cross the Pacific BOA via nine Control Area Extension corridors off the California coast.

3.2.10.3 Biological Resources

Marine biology of the open ocean consists of the animal and plant life that lives in and just above the surface waters of the sea and its fringes.

3.2.10.4 Geology and Soils

The Pacific Ocean floor of the central Pacific basin is relatively uniform, with a mean depth of about 4,270 meters (14,000 feet). (Oceans of the World, 2003) The Pacific Ocean is surrounded by a zone of violent volcanic and earthquake activity sometimes referred to as the "Pacific Ring of Fire." Icebergs are common in the Davis Strait, Denmark Strait, and the northwestern Atlantic Ocean from February to August and have been spotted as far south as Bermuda and the Madeira Islands. (Oceans of the World, 2003)

The principal feature of the bottom topography of the Atlantic BOA is a great submarine mountain range called the Mid-Atlantic Ridge. It extends from Iceland in the north to approximately 58 degrees south latitude, reaching a maximum width of about 1,600 kilometers (1,000 miles).

The Mid-Ocean Ridge dominates the terrain of the Indian Ocean floor. The Indian Ocean is subdivided by the Southeast Indian Ocean Ridge, Southwest Indian Ocean Ridge, and the Ninetyeast Ridge. (CIA, 2003)

Ocean sediments are composed of terrestrial, pelagic (open sea), and authigenic (grows in place with a rock) material. Terrestrial deposits consist of sand, mud, and rock particles formed by erosion, weathering, and volcanic activity on land and then washed to sea. (Wikipedia, 2003) Occasional icebergs occur in the southern reaches of the Indian Ocean. (CIA, 2003)

3.2.10.5 Hazardous Materials and Hazardous Waste

For test events using sea-based platforms, hazardous materials would be handled and used in accordance with all applicable state and Federal regulations as well as range-specific and U.S. Navy standard operating procedures.

The Clean Water Act prohibits the discharge of hazardous substances into or upon U.S. waters out to 370 kilometers (200 nautical miles). Also shipboard waste handling

procedures for commercial and U.S. Navy vessels govern the discharge of hazardous wastes as well as non-hazardous waste streams. These categories include “blackwater” (sewage); “greywater” (leftover cleaning water); oily wastes; garbage (plastics, non-plastics, and food-contaminated waste); hazardous wastes; and medical wastes. (U.S. Department of the Navy, 2002b)

The Uniform National Discharge Standards provisions of the Clean Water Act provide for the evaluation of the 39 discharges from U.S. Navy Vessels. Section 312(n)(2)(B) of the Clean Water Act identifies seven factors for consideration when determining if a discharge requires a marine pollution control device: the nature of the discharge; the environmental effects of the discharge; the effect that installing or using the marine pollution control device has on operations or the operational capability of the vessel; applicable Federal and state regulations; applicable international standards; and the economic costs of installing and using the marine pollution control device.

Under the regulations implementing the Act to Prevent Pollution from Ships, as amended, and the Marine Plastics Pollution Research and Control Act, the discharge of plastics, including synthetic ropes, fishing nets, plastic bags, and biodegradable plastics, into the water is prohibited. A slurry of sea water, paper, cardboard, or food waste that is capable of passing through a screen with opening no larger than 12 millimeters (0.4 inch) in diameter may not be discharged within 5.6 kilometers (three nautical miles) of land. Discharge of floating dunnage, lining, and packing materials is prohibited in navigable waters and in areas offshore less than 46.3 kilometers (25 nautical miles) from the nearest land.

Test event sponsors would be responsible for tracking hazardous wastes; for proper hazardous waste identification, storage, transportation, and disposal; and for implementing strategies to reduce the volume and toxicity of the hazardous waste generated. For test events using a sea-based platform, hazardous materials and hazardous waste would be managed in accordance with all applicable state and Federal regulations as well as Range-specific and U.S. Navy standard operating procedures.

The transport, receipt, storage, and handling of hazardous materials would comply with Army TM 38-410, Navy NAVSUP PUB 505, Air Force AFR 69-9, Marine Corps MCO 4450-12 or Defense Logistics Agency DLAM 4145.11, Storage and Handling and Implementing Regulations Governing Storage and Handling of Hazardous Materials.

3.2.10.6 Health and Safety

The region of influence for health and safety in the BOA would be limited to work crews located on sea-based platforms. The WorldWide Navigational Warning Service is a worldwide radio and satellite broadcast system for the dissemination of Maritime Safety Information to U.S. Navy and merchant ships. The WorldWide Navigational Warning

Service provides timely and accurate long range and coastal warning messages promoting the safety of life and property at sea and Special Warnings that inform mariners of potential political or military hazards that may affect safety of U.S. shipping.

3.2.10.7 Noise

Studies of ambient noise of the ocean have found that the sea surface is the predominant source of noise above the water, and that the source is associated with the breaking of waves. (Knudsen, et al., 1948, as referenced in FAA, 2001a) The primary human-made noise source within the BOA is associated with ship and vessel traffic, including transiting commercial tankers and container ships, commercial fishing boats, and military surface vessels and aircraft. Noise sources above the water would also include launch or other activities from sea-based platforms.

Noise also occurs under the ocean surface. The dominant sources of ambient underwater noise and their corresponding frequency ranges are seismic activity, turbulent-pressure fluctuations, and second order pressure effects due to surface gravity waves (1to 100 Hz); ship traffic and industrial activity (10 Hz to 10 kHz); biologics (10 Hz to 100 kHz); sea ice activity (10 Hz to 10kHz); breaking waves, bubbles, and spray (100 Hz to 20 kHz); precipitation (100 Hz to 30 kHz); and thermal effects (30 to 100 kHz). Noise from sources above the water may be magnified underwater. For example, a tug and barge produces sound that measures 171 dB in water and 110 dB in air. (Gisiner, 1998)

3.2.10.8 Transportation

The Transportation in the BOA consists predominantly of marine shipping. Marine shipping refers to the conveyance of freight, commodities, and passengers via mercantile vessels.

3.2.10.9 Water Resources

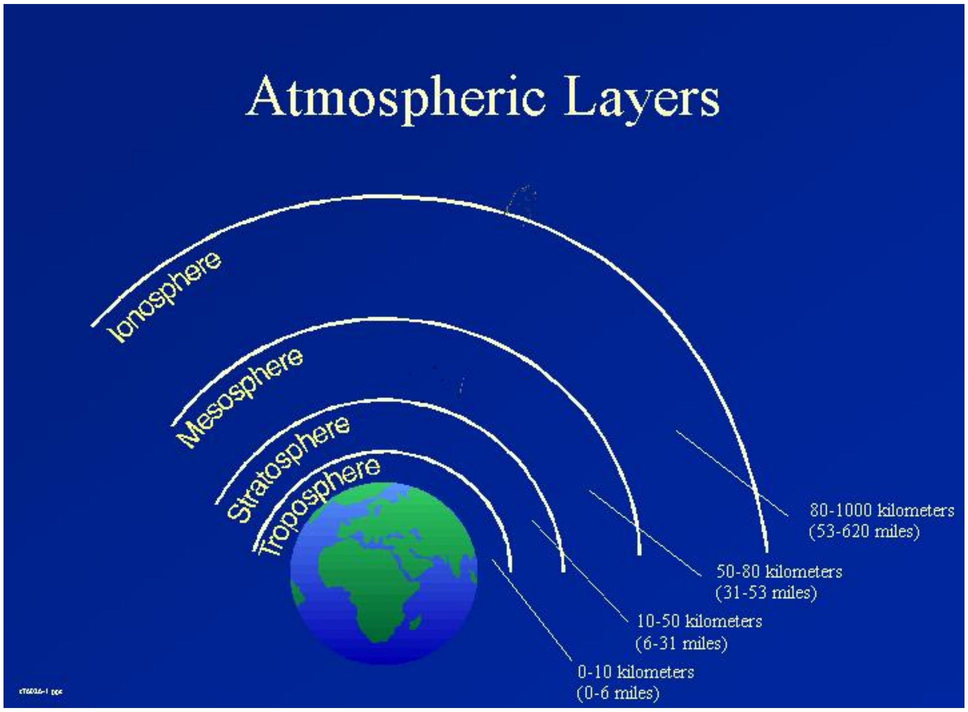
The two main factors that define ocean water are the temperature and the salinity of the water. (UCAR, 2001b) Water quality in the open ocean is considered excellent, with high water clarity, low concentrations of suspended matter, dissolved oxygen concentrations at or near saturation, and low concentrations of contaminants such as trace metals and hydrocarbons

3.2.11 Atmosphere

The Atmosphere Environment refers to the Atmosphere that envelops all areas of the Earth and consists of the four principal layers of the Earth's atmosphere: troposphere,

stratosphere, mesosphere, and ionosphere or thermosphere.[50] These layers are characterized by altitude, temperature, structure, density, composition, and degree of ionization – the positive or negative electric charge associated with each layer. Altitude ranges for atmospheric layers are described in Exhibit 3-21.

Exhibit 3-21. Altitude Range for Atmospheric Layers



Source: ICF Kaiser for Beal Aerospace, 1998

3.2.11.1 Air Quality

During the past 150 years, combustion of fossil fuels has resulted in increasing concentrations of atmospheric gases that are believed to influence global climate. The temperature of the Earth's atmosphere is determined by three factors: the sunlight it receives, the sunlight it reflects, and the infrared radiation absorbed by the atmosphere. The principal absorbers include CO_2, water vapor, nitrous oxide, chlorofluorocarbons (CFCs), and methane.

3.2.11.2 Airspace

Exhibit 3-22 illustrates the relationship between airspace classifications and atmospheric layers.

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[50] Most resource areas do not apply to the Atmosphere. Therefore, the Affected Environment discussion includes only Air Quality, Airspace, and Biological Resources, and consideration of Orbital Debris.

Exhibit 3-22. Relationship Between Airspace Classifications and Atmospheric Layers

Type of Airspace	Altitude (from MSL)	Atmospheric Layer(s)
Controlled	> 5.5 kilometers (3.4 miles)	Troposphere, Stratosphere
Uncontrolled	< 4.4 kilometers (2.7 miles)	Troposphere

3.2.11.3 Biological Resources

While the atmosphere generally is not considered to contain biological resources, atmospheric conditions have a direct impact on climate, which affects the location and health of biological resources.

3.2.11.4 Orbital Debris

Although there is no absolute definition of space, it can generally be defined at an altitude approximately 100 kilometers (62 miles) from the Earth's surface, where the aerodynamic forces of the thinning atmosphere become so small that the various control surfaces of an aircraft (e.g., rudder, aileron, and elevator) cease to function effectively. Space is not generally considered to be part of the human environment, as defined by NEPA and therefore, the discussion of impacts to space for this PEIS will be limited to the impacts from orbital debris. Orbital debris is man-made material introduced by spacecraft. The debris can be as large as spent rocket motors and as small as dust particles released during motor firings. Orbital debris that remains on orbit could create hazards to orbiting spacecraft, to astronauts or cosmonauts engaged in extra-vehicular space activities and it could have impacts upon reentry if the debris reaches the Earth's surface in large pieces or contains hazardous components. The effects of orbital debris on other spacecraft depend on the altitude, orbit, velocity, angle of impact, and mass of the debris. Eventually this orbiting debris loses energy and drops into consecutively lower orbits until it reenters Earth's atmosphere. Orbital debris has no impact on the human environment unless and until the debris enters the Earth's atmosphere. De-orbiting debris (i.e., debris reentering the atmosphere from orbit) is a potential concern as a course of deposition of small particles into the stratosphere, and a possible contributor to stratospheric ozone depletion.

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4 ENVIRONMENTAL CONSEQUENCES

Introduction

This Section of the PEIS describes the potential environmental consequences of implementing the proposed action via Alternatives 1 and 2 in various worldwide biomes, the BOA or the atmosphere. This Section also identifies potential cumulative impacts associated with those alternatives. It is intended to address the impacts in the context of worldwide biomes based on similar ecological characteristics rather than political boundaries. Only BMDS Programs and activities that are considered reasonably foreseeable are analyzed in this PEIS. Programs that are still conceptual in nature are not analyzed in this document.

This PEIS provides a comprehensive, global analytical framework that can support subsequent analysis of specific actions at specific locations, as appropriate. A description of the analytical framework follows in the next section. The manner and extent to which future actions tier from the PEIS is left to the discretion of the preparer. The framework established in this document is intended to serve as a guide for preparing future site-specific documents and does not dictate their preparation.

This PEIS also contemplates BMDS activities outside the jurisdictional limits of the U.S. and therefore beyond the scope of NEPA and other Federal U.S. laws. The DoD addresses these issues primarily in DoD Directive 6050.7 and DoD Instruction 4715.5. See Appendix G for a description of the framework to be used for this process.

Cumulative impacts of Alternatives 1 and 2 are also considered. The CEQ NEPA regulations define cumulative impacts as the impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR § 1508.7).

Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. For this PEIS, potential cumulative impacts are addressed for activities that would occur on a scale similar to the proposed BMDS. Thus, activities were considered that are national or international in scope. Future activities were identified based on review of worldwide rocket launches and commercial and government space programs.

As a result of the public comment process, additional areas of analysis – orbital debris, perchlorate, and radar impacts on wildlife – have been addressed in more technical detail in Appendices L, M, and N, respectively.

Analysis Process

Because of the extensive nature of this project, this PEIS analyzes the BMDS as described in the following four steps.

- **Step 1 – Identify and Characterize Activities** for each BMDS component.
- **Step 2 – Identify Activities with No Potential for Impact** and dismiss those for which prior NEPA analysis determined insignificant impacts or those that are categorically excluded.
- **Step 3 – Identify Similar Activities across Life Cycle Phases** for activities that are determined to have similar environmental impacts.
- **Step 4 – Conduct Environmental Analyses** for the remaining life cycle activities for each component.

Step 1 – Identify and Characterize Activities

The BMDS is organized by component (i.e., weapons; sensors; C2BMC; and support assets). Each component has life cycle activities associated with developing, testing, deploying, and decommissioning those components within the BMDS. These activities produce environmental impacts which are examined in this PEIS.

To consider impacts of the BMDS, the emissions/stressors from the component life cycle activities were identified and characterized. Exhibit 1-3 displays the typical activities within each life cycle phase for each component.

Step 2 – Identify Activities with No Potential for Impact

Actions for which previous NEPA analyses indicated no significant impacts[51] or actions that are normally categorically excluded[52] were not analyzed in detail in this PEIS. Exhibit 4-1 identifies activities for which categorical exclusions are generally available. These activities are not further analyzed in this PEIS.

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[51] After scrutinizing NEPA documents for programs and elements (see Appendix D), it was determined that there was no significant impact from several BMDS life cycle activities because these activities have been previously analyzed and were shown to have no impact.

[52] In accordance with CEQ regulations for implementing NEPA (40 CFR 1507.3(b)), the DoD and military services have developed regulations that provide for the establishment of categorical exclusions (40 CFR 1507.3(b)) for those actions, which do not individually or cumulatively have a significant impact on the human environment. Where appropriate, DoD and military services have established categorical exclusions for such activities. For example, infrequent, temporary (less than 30 days) increases in air operations up to 50 percent of the typical installation aircraft operation rate are categorically excluded. See Appendix G, Exhibit G-1 for citations of DoD NEPA implementing regulations categorical exclusions.

Exhibit 4-1. Life Cycle Activities Determined to Have No Significant Environmental Impact

Life Cycle Phase	Activities
Development	Planning/Budgeting
	Research and Development
	Systems Engineering
	Tabletop Exercises
Deployment	Training

Some activities such as transportation of components, maintenance and sustainment, and manufacturing were determined to need no further analysis in this PEIS either because they have been categorically excluded or addressed in previous NEPA analyses and found to have no significant impacts. The rationale for these conclusions is presented in Sections 4.1.1.8, 4.1.1.9, and 4.1.1.10, respectively, of this PEIS.

Step 3 – Identify Similar Activities across Life Cycle Phases

The remaining activities with the potential for environmental impacts were then examined to determine which had similar environmental impacts. For example, impacts associated with site preparation and construction in the development phase would be similar to or the same as impacts from site preparation and construction activities in the testing and deployment phases of the life cycle. Accordingly many activities were addressed together to eliminate redundancy.

Many activities in the various life cycle phases have been combined in the analysis of Support Assets. This was done because activities associated with support assets whether infrastructure, equipment or test assets (including countermeasures and simulants), were considered similar in terms of impacts created. Some activities require the use of operating platforms, such as aircraft for air-based components or ships for sea-based components; these specific platforms are considered support assets. Impacts from the use of operating platforms are discussed as part of Support Assets. Details of the life cycle phase analysis are provided below (Life Cycle Phase Activities). Exhibits 4-2 through 4-5 illustrate by life cycle phase, the activities that are analyzed in this PEIS and the corresponding section in which the analysis can be found.

Step 4 – Conduct Environmental Analyses

The significance of an impact that an activity has on the environment is a function of the nature of the receiving environment. For example, a booster launch has different emissions than those from activating a chemical laser. Whether those emissions create

impacts and the degree of significance of these impacts depends upon the environment in which they are released.

In this analysis, the PEIS considers the emissions/stressors from each component's activity in the context of each resource area (e.g., air, water, etc.). Impacts were distinguished based on the different operating environments (land, sea and air for Alternative 1 and land, sea, air and space for Alternative 2) in which the activity would occur. These impacts were further distinguished based on the worldwide biomes in which the activity would occur.

As a result, the PEIS is organized by component; the analysis examines each resource area and distinguishes between operating environments in the context of a particular biome. The analysis also describes where the impacts differ based on the operating environment or biome.

Life Cycle Phase Activities

Development Phase Activities

Exhibit 4-2 shows the activities in the development life cycle phase that were considered to produce environmental impacts and where in the analysis each activity is addressed. Planning and budgeting; research and development; systems engineering; and tabletop exercises are activities for which categorical exclusions are generally available; therefore these activities are not further analyzed in this PEIS. Manufacturing of prototypes and maintenance and sustainment are routine activities that have been considered in previous NEPA analyses and determined to have no significant impact or are categorically excluded and are not considered further in this PEIS. Site preparation and construction and testing are part of other life cycle phases for the proposed BMDS. To eliminate redundancy these activities are addressed together. Testing of component prototypes has been assumed to cause the same or similar impacts as testing of component as described for the test life cycle phase.

Exhibit 4-2. Analysis of Impacts of Development Phase Activities

Activity	Source of Impact	Impacts Analysis
Planning/Budgeting	None	Routine activity categorically excluded; not further analyzed
Research and Development	None	Routine activity categorically excluded; not further analyzed
Systems Engineering	None	Routine activity categorically excluded; not further analyzed

Exhibit 4-2. Analysis of Impacts of Development Phase Activities

Activity	Source of Impact	Impacts Analysis
Site Preparation and Construction	Construction or modifications necessary to support component prototype development	Section 4.1.1.9 Support Assets - Infrastructure
Maintenance or Sustainment	Activities related to hardware or software upgrades or maintenance of component prototypes	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.9 Support Assets - Infrastructure
Manufacturing of Prototypes	Manufacturing of component prototypes	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
Testing of Component Prototypes	Activities related to activation or use of the component prototypes	Sections 4.1.1.1 Weapons - Lasers, 4.1.1.2 Weapons - Interceptors, 4.1.1.3 Sensors - Radar, 4.1.1.4 Sensors - Infrared and Optical, 4.1.1.5 Sensors - Laser, 4.1.1.6 C2BMC - Computer Terminals and Antennas, 4.1.1.7 C2BMC - Underground Cable, 4.1.1.8 Support Assets - Equipment, 4.1.1.9 Support Assets - Infrastructure, 4.1.1.10 Support Assets - Test Assets
Tabletop Exercises	None	Routine activity categorically excluded; activity not further analyzed

Test Phase Activities

Test life cycle phase activities were considered in two distinct analyses; one focused on the components and their individual test activities, and the other focused on System Integration Testing which could include multiple components with one or more attempted intercepts to test system capability and effectiveness in increasingly robust and realistic test scenarios.

BMDS *component testing activities* assumed to have potential impacts on the environment were considered for each component as shown in Exhibit 4-3. Some of the activities that comprise the test life cycle phase are unique to individual components. For example launch/flight is relevant for interceptors and targets but not for C2BMC. Test life cycle phase activities are specific to each component. Therefore, Exhibit 4-3 is presented by component and shows those specific activities that were determined to have the potential for impact. Other activities such as site preparation and construction are not unique to individual components and are therefore considered collectively in Support Assets. The impacts associated with a target intercept involving either laser or interceptor weapons are addressed as part of Test Integration.

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
Weapons-Laser	Manufacturing of Test Articles	Manufacturing/assembly of laser components and chemicals	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support laser use/firing	Section 4.1.1.9 Support Assets - Infrastructure

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
	Transportation	Transport of the laser and chemicals to appropriate location	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Firing the laser	Section 4.1.1.1 Weapons - Lasers
Weapons-Interceptor	Manufacturing of Test Articles	Manufacturing interceptor components and propellants	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support launch	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of the booster, kill vehicle, and propellants to the launch location	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Prelaunch	Assembly and fueling of the booster or kill vehicle, as appropriate	Section 4.1.1.2 Weapons - Interceptors

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
	Launch/Flight	Ignition of rocket motors and flight of boosters or separation of kill vehicle and subsequent flight along its trajectory	Section 4.1.1.2 Weapons - Interceptors
	Postlaunch	Clean up or debris recovery, if required	Section 4.1.1.2 Weapons - Interceptors
Sensors	Manufacturing	Manufacturing/assembly of the sensor hardware and software	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support sensor use	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of the sensor to appropriate location	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Use of the sensor	Sections 4.1.1.3 Sensors - Radar, 4.1.1.4 Sensors - Infrared and Optical, and 4.1.1.5 Sensors - Laser

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
C2BMC	Manufacturing	Assembly of associated hardware and software	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modification for computer terminals, antennas, and underground cable trenching	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of C2BMC to appropriate location	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Use of computer terminals, antennas, and underground cable	Sections 4.1.1.6 C2BMC - Computer Terminal and Antennas, 4.1.1.7 C2BMC - Underground Cable

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
Support Assets-Support Equipment	Manufacturing	New or major modification of existing support equipment	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Operational Changes	Implementation of new operating parameters of existing support equipment	Section 4.1.1.8 Support Assets - Equipment
	Site Preparation and Construction	New construction or major modification of existing infrastructure	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of support equipment	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
Support Assets-Infrastructure	Site Preparation and Construction	Construction or modification of infrastructure	Section 4.1.1.9 Support Assets - Infrastructure

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
Support Assets- Test Assets	Manufacturing	Assembly of hardware/software associated with the test sensor	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support the test sensor or launch	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of the sensor, booster and propellants to the test location	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Use of the test sensor in a test event	Section 4.1.1.3 Sensors - Radar, 4.1.1.4 Sensors - Infrared and Optical, and 4.1.1.5 Sensors - Laser
	Prelaunch	Assembly and fueling of the booster as appropriate	Section 4.1.1.2 Weapons - Interceptors

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
	Launch/Flight	Ignition of rocket motors, separation from launch platform, and flight of the boosters or separation of the target object and subsequent flight along its trajectory	Section 4.1.1.2 Weapons - Interceptors
	Use of Countermeasures, Simulants or Drones	Use and deployment of various countermeasures, simulants or drones to support testing	Section 4.1.1.10 Support Assets - Test Assets
	Postlaunch	Clean up or debris recovery to include launch platform, countermeasures, and simulants, if required	Section 4.1.1.2 Weapons - Interceptors

The operating environments in which test activities occur (i.e., land, sea, air, and space) were determined to influence the environmental impacts only for laser activation, launch/flight activities, sensor activation, and activation of C2BMC. Therefore, these activities were also considered by operating environment in analyzing their environmental effects. Individual component tests are needed to demonstrate the functionality of BMDS technology. Potential environmental consequences of component tests are discussed in previous NEPA documentation and in their respective sections in this PEIS.

BMDS *System Integration Testing activities* would occur at the system level. System Integration Tests evaluate the ability of various component configurations to work together. System Integration Testing would be used to assess the ability of BMDS components to work interoperably and to meet the required functional capabilities of the BMDS as a system and to demonstrate performance.

System Integration Tests would integrate existing and planned components such as sensors, weapons, and C2BMC. This PEIS assesses the potential for environmental impacts of integrated BMDS testing activities under Alternatives 1 and 2. Test integration activities would involve land-, sea-, and air-based operating environments for weapons; and land-, sea-, air- and space-based operating environments for sensors, C2BMC, and support assets for Alternative 1. Assessment of Alternative 2 considers

only the additional impacts of proposed space-based operating environment for interceptors.

System level tests would include modeling, simulation, and analysis; integrated missile defense wargames; MDIE; integrated GTs; and SIFTs. A description of each type of test is provided in Exhibit 2-22.

The analysis of intercept impacts includes discussion of the impact of debris from an intercept. Depending on the location used for testing or deployment of weapons, debris may impact either inland or in marine environments. Therefore, impacts from postlaunch activities involving intercepts have been subcategorized based on where intercept debris would be likely to impact. For purposes of this PEIS, it was assumed that the debris impacts from any single intercept would occur within a single receiving environment, either on land or in water.

Deployment Phase Activities

Deployment phase activities with the potential for impacts on the environment would include manufacturing (production) of components, site preparation and construction, use of human services, transportation of components to the deployment site, testing (prelaunch, launch/flight, activation, postlaunch), training, and maintenance or sustainment of the components (operation and maintenance, upgrades, and service life extension). The environmental impacts associated with maintenance including hardware and software upgrades and service life extension are routine activities that are generally categorically excluded and are not analyzed in this PEIS. The environmental impacts associated with manufacturing, site preparation and construction, and transportation, and human services are routine activities that are generally categorically excluded or are analyzed in previous NEPA documents and found to have no significant impact. The rationale for why they are not analyzed in this PEIS is provided in Support Assets. The environmental impacts associated with training would be similar to the use of the component as described under the testing life cycle activity.

Future deployment of BMDS components would occur at times and places where the deployed component would provide the most useful defensive capability to counter existing or emerging threats. This could include sites outside the continental U.S. The environmental impacts of deployment at specific locations would need to be considered in subsequent site-specific NEPA analyses tiered from this PEIS. The activities and associated impacts from deployment phase activities are presented in Exhibit 4-4.

Exhibit 4-4. Analysis of Impacts of Deployment Phase Life Cycle Activities

Activity	Source of Impact	Impacts Analysis
Manufacturing	Manufacturing (production) of the component	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
Site Preparation and Construction	Construction or modifications necessary to support component deployment	Section 4.1.1.9 Support - Infrastructure
Transportation	Transporting component to deployment location	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets – Equipment
Testing	Activities related to prelaunch, launch/flight, postlaunch, or activation of the component	Testing of components would be the same as or similar to the use of the component as described under the testing lifecycle activity
Maintenance or Sustainment	Activities related to hardware or software upgrades	Activities related to prelaunch, launch/flight, postlaunch, or activation of the component
Upgrades	No source of impact	Routine activity categorically excluded; activity not further analyzed
Training	Activities related to prelaunch, launch/flight, postlaunch, or activation of the component	Testing of components would be the same as or similar to the use of the component as described under the testing life cycle activity
Use of Human Services	Activities related to increasing the presence of staff at deployment sites	The use of human services is more appropriately addressed in site specific documentation. Rationale presented in Section 4.1.1.9 Support Assets - Infrastructure

Exhibit 4-4. Analysis of Impacts of Deployment Phase Life Cycle Activities

Activity	Source of Impact	Impacts Analysis
Service Life Extension	No source of impact	Routine activity categorically excluded; activity not further analyzed

Decommissioning Phase Activities

Typical decommissioning phase activities would include demilitarization and disposal or replacement of the component. Activities associated with decommissioning may include recycling and disposal of hazardous materials. The activities associated with decommissioning are presented in Exhibit 4-5. The environmental impacts associated with decommissioning of specific components would be more appropriately addressed in subsequent tiered environmental analyses.

Exhibit 4-5. Analysis of Impacts of Decommissioning Phase Life Cycle Activities

Activity	Source of Impact	Impacts Analysis
Demilitarization	Destruction of offensive or defensive systems capability which may include disposal or detonation of hazardous materials (propellants, batteries, etc)	A roadmap for considering decommissioning impacts is provided; an analysis would be more appropriately addressed in subsequent tiered environmental analyses.
Disposal	Materials to be disposed may include hazardous materials and hazardous waste (propellants, coolants, batteries, etc.)	A roadmap for considering decommissioning impacts is provided; an analysis would be more appropriately addressed in subsequent tiered environmental analyses.

A roadmap for considering impacts of decommissioning for each component has been developed and is provided below. A Government depot or contractor may accomplish demilitarization and disposal of the components. The military service responsible for managing each piece of equipment would initiate the demilitarization and disposal process. Normally, each individual piece of equipment would have disposition instructions that have been prepared by its development contractor or project office in the case of MDA. These instructions identify the hazardous materials contained in the equipment item. A copy of the disposition instructions would be provided to the depot or contractor performing the demilitarization and disposal. It would be the responsibility of the depot or contractor to identify, remove, segregate, package, and document all hazardous materials in the item. In the case of a depot, disposal of hazardous materials

would be through Government channels as described below. When a contractor is utilized, hazardous materials disposal would be processed through commercial channels in compliance with all applicable Federal, state, and local laws.

When a depot performs the demilitarization and disposal functions, disposal of hazardous and nonhazardous materials would be through a Defense Reutilization and Marketing Office (DRMO). The DRMO would physically accept and process all property that falls within the DRMO area of responsibility. The DRMO would be responsible for disposing of hazardous materials in accordance with applicable Federal, state, and local laws, utilizing best management practices.

Components would be transported to demilitarization and disposal locations by the method appropriate to their location and military sensitivity. Transportation to contiguous land areas could be by ground (truck or rail) in accordance with DOT, state and local transportation and safety regulations and procedures. Transportation from, or to, island locations would be by aircraft in accordance with DOT and U.S. Air Force regulations and procedures, or by U.S. Navy, U.S. Army, or commercial ships in accordance with U.S. Coast Guard and Maritime Administration requirements and any other applicable regulations and procedures.

Potential decommissioning activities for weapons, sensors, C2BMC, and support assets are discussed below.

Decommissioning of ***weapons*** components would involve transferring the equipment to other uses, as described above, or demilitarization in accordance with the requirements of DoD 4160.21-M-1, Appendix 4 "*Demilitarization Requirements for Munitions List Items*." Specific requirements are found in DoD 4160.21-M-1, Appendix 4, Category IV, "*Launch Vehicles, Guided Missiles, Ballistic Missiles, Rockets, Torpedoes, and Components*," and DoD 4160.21-M-1, Appendix 4, Category V "*Military Explosives, Solid and Liquid Propellants, Bombs, Mines, Incendiary Agents, and Their Constituents*." Because the BMDS does not include nuclear weapons, the requirements of DoD 4160.21-M-1, Appendix 4, Category XVI, "*Nuclear Weapons Design and Test Equipment*," would not apply to the decommissioning of weapons components. Examples of potential decommissioning plans for missiles (interceptors and targets) are included below.

Decommissioning of missiles would first require the removal and proper disposal of liquid, solid, or hybrid (liquid and solid combination) propellants from the booster(s). Where possible, propellants would be recovered and reused. Aging motors that contain flaws would likely be decommissioned using open detonation. Some liquid fueled missiles are fueled only before a scheduled launch; others are pre-fueled. In addition, the kill vehicle on an interceptor missile typically uses liquid hypergolic propellants and some solid propellants for its divert and attitude control system. Liquid propellants would need to be emptied before disassembly of the missile could occur. Solid rocket

propellant would be removed for reclamation or burning in a controlled environment, such as an incinerator. Where practicable, incineration or closed burning of rocket propellant would be performed. Most of the acid and particulates ejected during the burn would be collected in plume scrubber water. This water would be treated for acceptance by a publicly owned (or federally owned) water treatment works or discharged in accordance with a National Pollutant Discharge Elimination System (NPDES) permit.

Decommissioning of lasers would require the removal and proper disposal or neutralization of chemical laser fuels from the storage facilities. Where possible, these chemicals would be recovered and reused. Decommissioning of the aircraft would be conducted in accordance with DOD 4160.21-M-1, Appendix 4, Category III, "*Military Aircraft (Combat, Tactical Air Vehicles) Spacecraft and Associated Equipment*" and other applicable requirements. Decommissioning activities for other laser components would be conducted as appropriate in accordance with applicable regulations.

The MDA would develop new ***sensor*** equipment in addition to using a variety of existing equipment. Equipment intended only for testing purposes and not for use in the BMDS architecture would be returned to the responsible military service for continuation of its original duties. Any decommissioning activities for this equipment would be carried out by the responsible military service. Equipment would be demilitarized in accordance with DoD 4160.21-M-1, Appendix 4, Category XII "*Fire Control, Range Finder, Optical, and Guidance and Control Equipment.*"

The decommissioning of sensors, equipment, and facilities would include the recycling/reuse or disposal of residual materials and unused products associated with the antennae, electronic, cooling, and power units. These products would include but are not limited to lubricants, coolants, batteries, and fuels. These materials would be decommissioned in accordance with Chapter 10, Environmentally Regulated and Hazardous Property, of the (DoD) Directive 4160.21-M, *Defense Reutilization and Disposal* and any applicable Federal, state, and local regulations and requirements. Reusable materials from sensors, such as metals, would be recovered. Other materials would be shredded and recycled or disposed of, as appropriate.

Sea-based sensors such as the SBX radar use a MOSS CS50 platform to support a radar support structure and radome. The CS50 platform was designed for use in oil exploration. After the sea-based radar system is removed, the platform could be converted to another MDA use (launch platform, test or deployed radar platform, etc.), transferred to a military service, or sold. If another use of the platform is not feasible, DoD would dismantle the platform and dispose of the materials by recycling, reuse, or discarding it in appropriate waste management facilities. DoD could also consider sinking the platform at sea after all toxic materials are removed, to provide a foundation for marine life.

Space-based sensors would be decommissioned by being abandoned in orbit, parked in a higher orbit, deorbited, or retrieved. Space-based sensors left in orbit that have non-BMDS utility could be transferred to alternate uses if economically feasible and the alternate use would not affect national security. Potential alternate uses include monitoring rocket launches and aircraft flights. DoD would make decisions on the disposition of the space-based components based on the stability of their orbits, the costs and risks of deorbiting or retrieval, the remaining useful life of the equipment, and potential for alternate uses.

Components could be retrieved from orbit and brought back to Earth for decommissioning and demilitarization if allowing them to remain in orbit poses unacceptable risks. Components abandoned in orbit would continue to orbit until gravitational and atmospheric drag cause the component to deorbit and reenter the atmosphere where it would either burn up or fall to Earth. Potential risks include danger to populations on Earth or the loss of equipment sensitive to national security. U.S. Space Command tracks orbits of satellites and space debris, and provides reentry predictions. When the predictions indicate a risk to land areas, a controlled deorbit would be considered to ensure reentry occurs over ocean areas. Parking the component in a higher orbit would increase the time before deorbit. Demilitarization of space-based components would be conducted in accordance with DoD 4160.21-M-1, Appendix 4, Category VIII, "*Military Aircraft (Combat, Tactical Air Vehicles), Spacecraft and Associated Equipment*," Category XI, "*Military and Space Electronics,*" and Category XV, "*Spacecraft Systems and Associated Equipment.*"

The MDA would develop new ***C2BMC*** equipment as well as use a variety of existing equipment. As technology advances and the needs of the BMDS evolve, multiple upgrades of C2BMC hardware and software are likely. DoD would be responsible for decommissioning activities in accordance with appropriate requirements for the specific C2BMC equipment.

Support assets include fixed facilities and mobile equipment as well as test assets including the test bed, test sensors, and targets. This discussion of decommissioning activities focuses on fixed and mobile equipment. Components that make up the test bed, test sensors and targets are addressed previously under decommissioning weapons and sensors.

Fixed facilities may include DoD-owned buildings located on ranges, installations, or related real estate such as islands temporarily used for BMDS purposes. Government contractor facilities include such sites as the Nevada Test Site and Sandia National Laboratory in New Mexico. Privately owned facilities include those owned by companies manufacturing components for the BMDS. Exhibit 4-6 describes decommissioning activities for fixed facilities.

Exhibit 4-6. Decommissioning Activities for Fixed Facilities

Fixed Facilities		*Decommissioning Activities*			
		Left in Place			**Disposed**
		Mission Realignment	Return to Owners/Host Facility	Transfer Title to New Owner	Transfer Land Title to New Owner
Buildings	DoD-owned	X		X	X
	Government Contractor		X		
	Private		X		
Launch Locations	DoD Launch Pads/Runways	X		X	X
	Silos	X			
	Other Government		X		
	Private		X		
	Municipal Airports (runways)		X		
Utilities	Water/Sewer Systems	X	X	X	X
	Power Plants (gas and coal fired)	X	X	X	X
	Fiber optic and Other Cables	X	X	X	X

Fixed buildings or structures could include those used for testing purposes, deployment, or both. As described above, the MDA would evaluate DoD-owned buildings for continued or adaptive use by the DoD or other U.S. Government agencies. Following the decision to decommission, any necessary decontamination activities would be performed. Buildings owned by the DoD that are not assigned new missions could be sold and the title transferred to the new owner. Any space devoted to BMDS activities in government contractor or contractor facilities would be returned to the host installation. All BMDS-related equipment would be removed according to decommissioning regulations.

Other fixed BMDS components include launch pads, in-ground missile silos, and runways. Launch pads, silos, and runways located at the various DoD installations, upon completing their BMDS mission, might be assigned new DoD missions and might not

need to be decommissioned. Other government launch facilities include those run by the NASA such as Kennedy Space Center.

Private facilities include those owned by states or private organizations such as the KLC, which is run by the Alaska Aerospace Development Corporation. Upon termination of any BMDS testing or deployment activities conducted on the grounds of these facilities, any private assets and components used by MDA to support testing or deployment would be returned to full control of the host installation or otherwise disposed per existing contractual agreement.

Utilities installed in new or existing facilities as part of the BMDS mission would include water/sewer systems and fiber optic or other cables. Depending on the decommissioning decision related to any related DoD-buildings or structures, utilities could be left in place if the potential existed to use them for future DoD or other entity purposes. They would either be passed to the existing owner or host installation if installed on contractor property. Should a related structure be transferred to a new owner, utilities likely would be left in place.

The scope of the BMDS includes some testing and potential deployment at locations abroad. Decommissioning options for international buildings, launch locations, or utilities would be the same as for domestic locations. However, it is expected that the extent of the BMDS presence in other countries would be less than in the continental U.S.

Mobile land-based components include transportation vehicles (e.g., trucks, vans and trains) and missile launchers. Equipment removed from the mobile land-based components would be refurbished and transferred to an alternate use, demilitarized, or dismantled and disposed. Upon completion of their BMDS mission, DoD-owned transportation vehicles would either be assigned another mission or be disposed or sold by DoD. Vehicles owned by government contractors or private companies would be returned to their original owners following any decontamination required. Missile launchers, such as the THAAD mobile launcher, which uses a U.S. Army Heavy Expanded Mobility Tactical Truck with Load Handling System Truck would be disassembled and disposed. Some missile launcher interiors were coated with a specialized paint containing chromium. Disposal of chromium contaminated paint dust or water used in the removal of the paint would require disposal according to applicable Federal and State regulations.

Following the decision to decommission, any necessary decontamination activities would be performed. Land areas would be restored to previous conditions or other condition compatible with planned land use of the site. Demilitarization of land-based components would be conducted in accordance with the applicable category of DoD 4160.21-M-1, Appendix 4 "*Demilitarization Requirements for Munitions List Items,*" or other applicable requirements. Disposal of land-based components would involve the removal

of BMDS equipment and assets. The components could be left in place and a new mission assigned for them. The components could be returned to the owners of the host facility (if not DoD-owned) or transferred to new owners. Transfer would occur under an interagency agreement, memorandum of understanding, lease agreement, or other agreement.

The MDA would decommission the three current airborne sensor aircraft (HALO I, HALO II, and Widebody Airborne Sensor Platform [WASP]) and future airborne sensors when they are no longer needed to support the MDA testing program. MDA would remove the sensors and other government property from the aircraft and then decommission the aircraft by transferring to another government agency, selling as excess government property, salvaging usable parts, or mothballing at a government airfield. MDA is currently purchasing the HALO aircraft.

Under the Measurements Program, countermeasures would be recycled or reused for alternate DoD missions. Simulants and submunitions used for lethality testing also would be recycled or reused, where possible, or disposed in accordance with applicable regulations.

4.1 Alternative 1 – Implement BMDS Using Land-, Sea-, and Air-Based Weapons Platforms

4.1.1 BMDS Components

The following analyses are organized by component and subcomponent. The analyses are specific to each resource area (i.e., air quality, airspace, biological resources, geology and soils, hazardous materials and hazardous waste, health and safety, noise, transportation, and water resources) based on the impacts from the life cycle activities associated with each component. Where activities that are not unique to the life cycle phase or component and have the potential to result in similar environmental impacts, they were addressed together to eliminate redundancy. Where activities that are not unique to an individual component and have the potential to result in similar environmental impacts, they were addressed together to eliminate redundancy. As previously discussed under the Description of Life Cycle Activities and Development Phase Activities, manufacturing, site preparation and construction, and transportation of components are discussed under Support Assets. Because such activities would be performed by or on support assets, the impacts from manufacturing, site preparation and construction, and transportation activities associated with each BMDS component are discussed under Support Assets.

4.1.1.1 Weapons - Lasers

As described in Exhibit 4-3, the analysis for lasers is based upon impacts from the activation of the laser.

Air Quality

Operation of a COIL would result in gaseous emissions of water vapor, CO_2, oxygen, helium, nitrogen (N_2), ammonia, chlorine, H_2, and iodine. Liquid hydrogen peroxide also would be released. Ammonia and chlorine are hazardous substances. At altitude, the gases produced by the laser are exhausted into the air. During activation from land and sea platforms (assuming that sea-based laser activation was done under the same test conditions used for ground testing), most of the gaseous emissions produced by the laser would be captured in an air pollution scrubber. The estimated quantities released and scrubbed (for laser activation from land and sea platforms) in a single lasing event are shown in Exhibit 4-7. (U.S. Department of the Air Force, 1997b)

Exhibit 4-7. Estimated In-Flight COIL Gaseous Emissions in Kilograms (Pounds)*

Chemical	Total Quantity Produced per Laser Activation Kilograms (Pounds)	Quantity of Emissions Released to Atmosphere for Air Platform Laser Activation Kilograms (Pounds)	Quantity of Emissions Captured in Solution by Scrubber for Land and Sea Platform Laser Activation Kilograms (Pounds)	Quantity of Emissions Released to Atmosphere for Land and Sea Platform Laser Activation Kilograms (Pounds)
Ammonia (recovered in closed-loop system)	N/A	N/A	N/A	N/A
Carbon dioxide	761 (1,677)	761 (1,677)	0 (0)	761 (1,677)
Chlorine	29 (63)	29 (63)	24 (53)	5 (10)
Helium/N_2	86 (190)	86 (190)	0 (0)	86 (190)
H_2	20 (43)	20 (43)	0 (0)	20 (43)
Iodine	10 (23)	10 (23)	9 (20)	1 (3)
Oxygen	219 (483)	219 (483)	0 (0)	219 (483)
Water	1,389 (3,063)	1,389 (3,063)	1,181 (2,603)	209 (460)

*Calculations subject to rounding
Source: U.S. Department of the Air Force, 1997b

Land and Sea Operating Environments

Impacts to air quality from the activation of the COIL from land or sea platforms would be minimal, given the short duration of the laser operation (less than 30 seconds [U.S. Department of the Air Force, 1997b]) and the propensity of hot gases in the emission

cloud to rise. Because a small amount of chlorine may remain after scrubbing and be released to the atmosphere, rain within two hours of laser activation could cause hydrochloric acid to form and be deposited in small quantities. (U.S. Department of the Air Force, 1997b)

Under high humidity or rainy conditions, chlorine exhaust would be removed from the atmosphere in a shorter amount of time, as the chlorine is converted to hydrochloric acid. Because of their humid climates hydrochloric acid would likely be produced as a result of laser activation in a number of biomes including Arctic Tundra Coastal, Sub-Arctic Taiga Coastal, Deciduous Forest, Deciduous Forest Coastal, and Mountain Biomes. In addition, hydrochloric acid could be produced in the Sub-Arctic Taiga, Chaparral, Grasslands, and Savanna Biomes when cool and humid conditions exist during laser activation activities. The strong winds in the BOA would support the rapid dispersion of emissions. Given the dry conditions in the Desert Biome, it is unlikely that chlorine would be converted to hydrochloric acid. The Tropical Coastal Biome is generally humid but the temperatures do not cool enough to convert any chlorine produced as a result of laser activation to hydrochloric acid.

Hydrochloric acid produced as a result of the interaction between laser emissions and moisture in the air has the potential to produce impacts on biological resources, including plants and aquatic animals, and water quality. The extent and relative significance of the impact depends on the site-specific receptors present at the location. However activation of lasers, in general, would result in a small amount of chlorine being converted to hydrochloric acid, which would be further diluted by rain water.

Air Operating Environment

Impacts to air quality from laser activation from air platforms would result in similar impacts to those discussed above for land and sea operating environments. However, the potentially harmful substances would be released at approximately 12,192 meters (40,000 feet) above the Earth’s surface and therefore, would be less likely to affect ground-level air quality. High exhaust gas temperature would result in positive buoyancy, allowing the exhaust emissions to rise quickly. The high exit velocity of the exhaust gases and the chemical composition of the exhaust would further increase the rate of dispersion and increase the altitude at which dispersion occurs. Therefore, the gases would not accumulate in any significant quantities, and no significant impact to air quality would be expected due to activation of lasers from air operating environments. (U.S. Army Space and Strategic Defense Command, 1998b)

If the COIL were operating in the upper reaches of the troposphere and in the lower stratosphere (up to 12 kilometers [7 miles]), chlorine exhaust emissions would be converted quickly to forms that dissolve in water and would be removed from the

atmosphere. (U.S. Department of the Air Force, 1997b) Chlorine may be converted to hydrochloric acid, which has the potential to increase the acidity of precipitation.

Ammonia is water-soluble and would dissolve in water and be removed from the atmosphere in approximately 20 days. (Seinfeld, 1986, as referenced in U.S. Department of the Air Force, 1997b) Emissions of chlorine and ammonia from the COIL would be insignificant compared to the amount of chlorine and ammonia released by industrial sources every year. (U.S. Department of the Air Force, 1997b) Emissions of CO_2 associated with operation of the COIL would be minimal and would not be expected to contribute significantly to global warming.

Chlorine is capable of destroying ozone, which is beneficial in the upper atmosphere for blocking harmful rays from the sun. If the emissions occur in the lower stratosphere (above the troposphere), the local concentration of chlorine would increase approximately 35 percent for a short period of time (less than 24 hours). (MDA, 2003a) The increased levels would return to background levels within several hours as atmospheric winds disperse the chlorine. Operation of the COIL in the stratosphere would be spread out over time, thereby eliminating the possibility for local, cumulative effects.

In the event that the aircraft is unable to land at the appropriate landing location, it may be necessary to jettison aircraft fuel and laser chemicals. The laser chemicals could be discarded at a minimum altitude of at least 4,572 meters (15,000 feet). Chemical dispersion modeling has shown that release of liquids used by the COIL at this altitude will not reach the ground and would be diluted in the atmosphere. (MDA, 2003a) Laser chemicals include hydrogen peroxide, ammonia, chlorine, helium, N_2, and iodine. Iodine would be carried as a solid and would not be jettisoned. If the chemicals could not be released at or above this height, the laser chemicals would remain onboard until the air operations could be grounded.

B-747 aircraft would be used for air-based lasers. B-747 fire suppression systems contain 150 kilograms (330 pounds) of Halon 1301 and 9 kilograms (20 pounds) of Halon 1211, both of which are Class I ozone-depleting substances that contribute to ozone depletion when released to the atmosphere. Use of Halon CFC fire suppression systems would take place only in emergency situations, which would be extremely rare. In the case of a fire, the amount of Halon released would be small compared to the amount of CFCs already present in the atmosphere. Fire suppression substitutes are being developed and evaluated and may be available for future operation of lasers in an air operating environment.

Airspace

Land and Sea Operating Environments

Ground testing of HELs that would occur in indoor facilities would have no effect on airspace in any biome considered in this PEIS. Outdoor activation of lasers from land or sea operating environments could impact the use of airspace. Close coordination with the FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impacts on airspace use. Activation of lasers would occur in cleared airspace within designated airspace areas.

Air Operating Environment

Laser activation from air platforms would occur at an altitude of approximately 12,192 meters (40,000 feet). The laser beam would be pointed horizontally or upward. Activation of lasers would occur in cleared airspace within designated airspace use. Close coordination with the FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impacts on airspace use.

Biological Resources

Land and Sea Operating Environments

Ammonia and chlorine produced from the land- and sea-based operation of the COIL could harm underlying vegetation and wildlife. Chlorine is known to injure plant leaves and affect wildlife. Direct effects could include discoloration, foliage loss, and changes in species composition. (U.S. Department of the Air Force, 1997b) Birds flying through the exhaust plume might be exposed to concentrations of hydrochloric acid, which could irritate eye and respiratory tract membranes. However, the high temperature of the emissions, the noise produced by support equipment, and visual cues of the emissions would likely cause birds to fly away from the launch area and therefore, prevent them from being exposed to the chlorine exhaust.

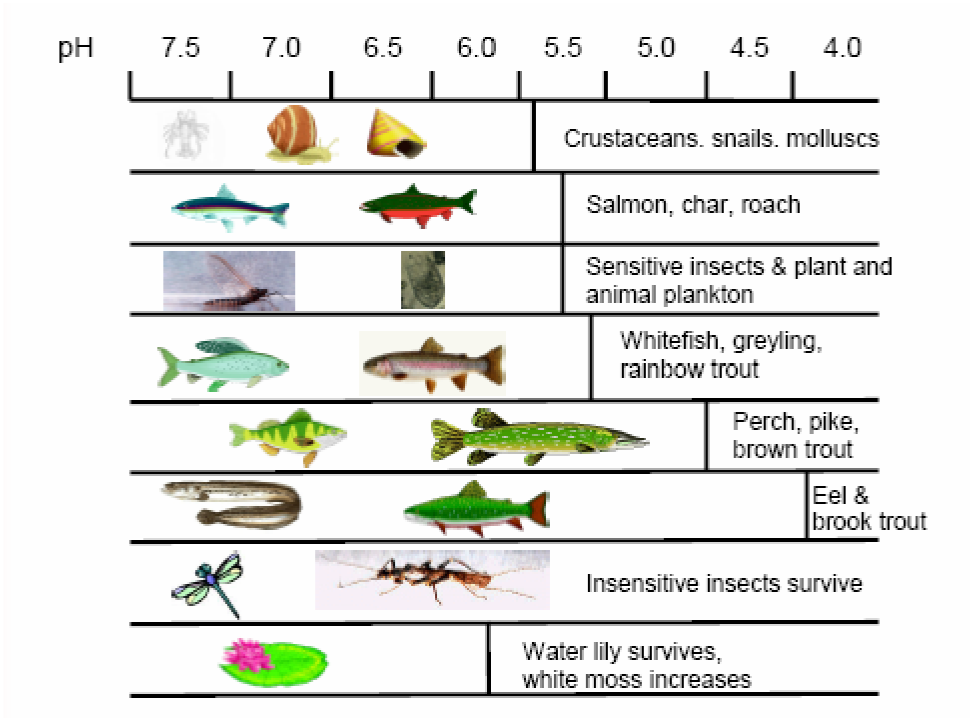
Furthermore, studies involving a variety of laser projects in New Mexico indicate that cumulative impacts to wildlife from laser propagation are negligible. (U.S. Army Corps of Engineers, 1989)

The presence of hydrochloric acid in freshwater bodies may cause temporary increases in water acidity and could alter the regular functioning of the aquatic ecosystem. However, saltwater tends to neutralize acid; therefore, significant acidification does not occur in the ocean and most estuaries, where freshwater and saltwater combine. (EPA, 2003g)

Nonetheless, deposition of HCl into the ocean may create a temporary hazard to marine wildlife. Special consideration should be given to any potential impacts to Essential Fish Habitat and efforts, such as scrubbing emissions, should be made to mitigate the impacts. Once deposited, hydrochloric acid would be diluted and dispersed by the receiving waters. Impacts would be limited to a small area surrounding the point of contact, as the waves and ocean currents would inhibit widespread deleterious effects to marine wildlife.

In environments where there are water bodies, including bogs, fens, marshes, shallow lakes, rivers, and wetlands, chlorine would be converted to an acidic form, where it could alter the pH of the water body. The activation of lasers would not be expected to cause a significant increase in water acidity; however, site-specific analyses would be needed to consider specific impacts to individual locations. In general, the Sub-Arctic Taiga Coastal, Deciduous Forest, Deciduous Forest Coastal, and Mountain Biomes are likely to have water bodies that could be affected by an increase in acidity. Much of the Deciduous Forest Biome is already affected by acidic precipitation; therefore, its regional flora and fauna may not be able to tolerate additional acidic toxicity from laser activation. The presence of hydrochloric acid in prairie potholes in the Grasslands Biome could lower the pH of the water (making it more acidic), which could have a negative effect on waterfowl, shorebirds, and waterbirds that stopover during migration and/or breed in the waters. Mountain lakes are particularly sensitive to the effects of acidification because they have soft water, which does not neutralize acid readily. Furthermore, mountain lake ecosystems quickly show the effects from an external input. As a result, some mountain lake wildlife might not be able to adapt to a lower pH level quickly enough to absorb the effects of increased water acidity without harm. (PECO/COPERNICUS, 1999) Other biomes including Arctic Tundra Coastal, Sub-Arctic Taiga, Chaparral Coastal, Desert, Tropical Coastal, BOA, and Savanna are unlikely to experience increased acidity in surface waters either because hydrochloric acid is unlikely to be produced as a result of laser activation or because surface water is uncommon in these areas. An increase in acidity could affect pH-sensitive aquatic species, as shown in Exhibit 4-8. This has the potential to adversely affect biodiversity; however, this potential affect would be limited to the areas surrounding the laser activation site. The overall increase in acidity, and therefore, the impact to biodiversity would not be expected to be significant.

Exhibit 4-8. Freshwater Species Tolerance to Acidity



Source: Atmosphere, Climate and Environment Information Programme, 2003

Species including birds, pinnipeds, and sea otters are less likely to be impacted by laser activation related noise than other noises. Given the short duration (less than 30 seconds) and proposed infrequent operation of the lasers, any startle responses in animals would be short-lived and localized to the area near the activation site. (U.S. Department of the Air Force, 1997b)

Indoor testing would be contained and would not damage vegetation or wildlife in any biome. During outdoor testing, laser beams could either be directed upwards toward air targets or horizontally towards ground targets. If the beam were directed at an upward angle, vegetation and terrestrial wildlife would not be affected. The probability of the laser beam striking a bird is very low. If the beam is directed horizontally toward ground targets, it could pose a fire hazard to vegetation or cause skin or eye damage to wildlife. Precautions would be taken to prevent harm to vegetation and wildlife.

When the light energy of the laser beam is focused, damage due to thermal heating of the retina or a photochemical change in the retina would most likely occur (in the same way that a magnifying glass can be used to focus light energy from the sun to produce a hot spot). (Swope, 1969, as referenced in U.S. Department of the Air Force, 1990) Damage to the fovea (a small part of the retina that provides acute vision) could result in a severe visual handicap. If the eye were not focused on the laser source, the light energy would not be focused to a point on the retina but would be spread out over a larger area of the

retina and would not be as likely to cause damage. Also, if the eye were pointed somewhere off to the side rather than directly at the source, any damage to the retina would be outside the fovea and would be less likely to produce severe visual handicap. (U.S. Department of the Air Force, 1990)

Ground testing of ABLs would use equipment that would simulate atmospheric conditions at the altitude where the laser would be used. The equipment would operate for a few minutes or less, and would generate noise that could affect wildlife. This noise could cause flushing in birds and temporary abandonment of nesting and other normal activities. These noises may startle animals and cause them to flee the area and abandon normal activities. However, studies indicate that birds and animals generally return to normal activities within a short time following noise disturbances. (Manci, et al., 1988) Specifically, a 1982 study by Stewart found that birds exposed to 115.6 to 145.5 dBA short intensity noise events returned to their nests within 2 to 10 minutes after the disturbance. (Stewart, 1982, as referenced in Manci, et al., 1988) In addition, a 1980 study by Jehl and Cooper used shotgun blasts and explosives to simulate short duration noise events and found that nesting birds returned within 30 seconds of the disturbance. (Jehl, J.R and C.F. Cooper, 1980, as referenced in Manci et al, 1988)

Air Operating Environment

Impacts to biological resources from laser activation from air platforms would result in similar impacts to those discussed above for land-based operations. However, the potentially harmful substances would be released at approximately 12,192 meters (40,000 feet) above the Earth's surface and therefore, would be less likely to affect human health, wildlife, or vegetation. Emissions would be diluted and dispersed quickly in the atmosphere. Terrestrial biota would not be exposed to significant concentrations of emissions. The laser beam would be pointed upward; and therefore, the test geometry would prevent the possibility of harming terrestrial wildlife directly from contact with the beam. Because the laser is activated in the upper troposphere or above, the potential for the beam striking birds in flight would be low.

A misdirected laser beam would have virtually no potential to impact any moving or stationary individual animal, either on land, in the air, or in the sea. The light energy would be reduced (i.e., less concentrated) and would be less able to cause injury because the beam's width would increase due to atmospheric refraction as it approached the Earth's surface. Exposure to the beam would be extremely short due to the rapidity with which the beam would swing past the animal or would be shut off; and therefore, damage would be minimal. (U.S. Department of the Air Force, 1990)

Geology and Soils

Land Operating Environment

Only small amounts of emissions from the operation of the COIL on the ground would be released and would not be expected to affect geology and soils in any biome. Ground testing equipment would receive the laser emissions and scrub them using a vacuum device before releasing them into the atmosphere. Use of the vacuum system would reduce the amount of emissions that could affect geology and soils.

Under rainy or humid conditions, a small amount of chlorine produced from the operation of the COIL would be deposited on the soil as hydrochloric acid, which could result in a temporary increase in soil acidity that might have a short-term effect on vegetation and soil-dwelling microorganisms. The intensity of the acidic effect is a function of the amount of limestone (calcium carbonate) in the soils.

Soils that are strongly leached (removed of nutrients, including calcium) and therefore, acidic could be adversely affected by the addition of hydrochloric acid which could further increase soil acidity. This could occur in the Arctic Tundra, Sub-Arctic Taiga, Savanna, Mountain and parts of the Deciduous Forest, and Tropical Biomes.

Soils with large amounts of calcium carbonate have nearly unlimited buffering capacities and rarely show effects of acidification. (EPA, 2003g) This would be true for soils in the Grasslands, and parts of the Deciduous Forest including Florida and islands in the Pacific and Atlantic Ocean that are limestone-based. However, many soils common throughout the Deciduous Forest Biome lack calcium carbonate due to the warm, humid climate that leads to rapid weathering and subsequent leaching of minerals in soils, including calcium and therefore might be subject to impacts from increased soil acidity.

The Chaparral and Desert Biomes would be unlikely to produce hydrochloric acid as a result of laser activation and therefore soils in these biomes would not be subject to acid deposition from this source.

Accidental releases of spent laser chemicals would be contained in accordance with site-specific spill plans that minimize impacts on geology and soils. In the case of an accidental fire, liquid and solid laser chemicals would either be consumed or contained. Chemicals consumed by the fire would be released as gases and would not impact geology or soils. Remaining laser chemicals would be contained by spill control measures and would be removed and disposed in accordance with standard procedures.

Air Operating Environment

Activation of lasers from an air platform would generally occur at approximately 12,192 meters (40,000 feet). Emissions would occur above the mixing height and might occur above the troposphere. Gaseous emissions occurring at this altitude would be dispersed and diluted in the atmosphere and would not reach the ground surface. Therefore, there would be no impact to geology and soils.

Sea Operating Environment

Laser activation on sea platforms would result in similar impacts to those discussed for land platforms. The small quantities of substances released would be dispersed by atmospheric winds or the motion of the ocean currents and waves without affecting geology and soils on the ocean floor beneath the sea operating environment.

Hazardous Materials and Hazardous Wastes

Land and Sea Operating Environments

COIL chemicals include chlorine (Cl_2), iodine, and hydrogen peroxide. Effluents from the operation of the HEL are managed by use of chemical scrubbers and chemical reactions that produce non-toxic by-products. The volume of waste would depend on site-specific activities. The use and disposal of hazardous materials would be incorporated into hazardous materials and hazardous waste management documents. Hazardous materials would be stored in a centralized location and Material Safety Data Sheets would be posted at all locations where hazardous materials are stored or used. All waste would be collected and segregated as nonhazardous, hazardous, and possibly special wastes for proper disposal in accordance with Federal, state, local, and DoD requirements. Personnel would follow safety procedures to prevent exposure. All hazardous materials used and hazardous waste generated would be handled in accordance with a Hazardous Waste and Hazardous Materials Standard Operating Procedure Manual as well as applicable legal requirements. (U.S. Army Space and Missile Defense Command, 2002d) Accidental releases of hazardous materials would be contained in accordance with a site-specific spill plan.

Laser activation activities would produce the same hazardous materials and hazardous waste impacts in all of the biomes considered in this PEIS. As discussed above for impacts to geology and soils, ground testing of lasers intended for use from air operating environments would use vacuum and scrubber devices to simulate atmospheric conditions at the proposed operating altitude. Scrubbing would generate hazardous wastewater that would be contaminated and corrosive. This contaminated water would be treated and disposed in accordance with applicable regulations.

Spent laser chemicals would be neutralized and reused elsewhere in the chemical mixing facility or disposed of as waste product. This waste would be handled, treated, and disposed in accordance with standard procedures, preventing the release of contamination. In the case of an accidental fire, liquid and solid laser chemicals would either be consumed or contained. Chemicals consumed by the fire would be released as gases and would not become hazardous waste. Remaining laser chemicals would be contained by spill prevention, countermeasure, and control plans, and would be removed and disposed in accordance with applicable regulations and standard operating procedures. Laser chemical and chemical waste storage areas would operate in accordance with appropriate regulations to minimize impacts from potential spills and/or leaks.

Air Operating Environment

Emissions from laser activation from air platforms would be vented to the atmosphere while the platform is at operational altitude. Thus, emissions would not reach the Earth, and would not require treatment as hazardous waste.

In the event of an accident on the runway causing rupture of fuel bladders on the B-747, the impact on geology, soil, or water resources from the jet fuels and firefighting materials would be similar to the impact from other aircraft accidents. The liquid and solid laser fuels released in an accident on the runway would be consumed by fire or contained, and the gaseous laser fuels would either burn or vent to the atmosphere where they would not impact geology, soils, or water quality.

Health and Safety

Land and Sea Operating Environments

Laser activation activities would produce the same impacts on health and safety in all of the biomes considered in this PEIS. A Material Safety Data Sheet would be made available for each hazardous chemical in use at the facility. Storage specifications for hazardous chemicals would prevent dangerous intermixing of reactive chemicals.

Exhaust emissions from laser activation have the potential to harm human health. A safety zone would be established around the laser during operation to prevent exposure to emissions. The general public and non-operational personnel would not be permitted in the safety zone during operations; and therefore, no impact on health and safety would be expected from exhaust emissions.

Before activation activities are conducted, components would be reviewed for hazards. Personnel would be trained to handle laser chemicals and operate the laser. During ground testing of lasers, the beam would be contained in a beam containment system at

all times. During sea-based operations, a laser hazard zone would be established to prevent non-essential personnel or bystanders from crossing the direct or reflected beam path of the laser.

An accidental release of laser chemicals and chemicals used to support laser operation would have the potential to affect health and safety of workers in the vicinity of the release. The primary scenarios for an accidental release involve the transfer of the reactants from the loading truck to the ground storage tanks, transfer from the storage tank to the test apparatus, a catastrophic storage container failure, and a massive release of hazardous chemicals resulting either from the slow combustion or the detonation of compounds where reactants are stored. (BMDO, 2001) Spill control procedures would be followed on military installations, and emergency response personnel would be trained to respond to such emergencies.

Laser beams can cause serious health problems if they contact the skin or eyes. Hazard distances would be determined for each laser depending on the hazardous and adverse biological impacts it has on the eye or skin. A spherical exclusion area would be established around the laser during operation. While the intended beam direction is the most likely hazard area, the spherical shape of the exclusion area would account for laser scatter, the intensity of which can be as strong as or weaker than the original beam. HELs are dangerous at the source of the laser beam, and they become more dangerous around the focus point, where the beam has the smallest cross-sectional area. The strength of a laser beam is attenuated and scattered as it moves through the atmosphere. Lower energy lasers (such as those used in laser sensing and tracking systems) may not be dangerous at the source of the beam, but may become dangerous around the focus point.

During ground testing activities, the laser beam would be directed away from population centers. Range areas would be used during ground testing and public access to these areas would be restricted. Laser targets would be designed to keep any spectral hazard on the range or to exit at a safe altitude. Hazard zones would be blocked off to prevent exposure to personnel. Target backstops would be used in case the laser misses the target.

Air Operating Environment

The accidental release of laser chemicals onboard an aircraft during flight would be highly unlikely. The accidental release of chemicals inside the aircraft during flight would not endanger the flight crew because the aircraft would include a pressure bulkhead that separates the chemical storage areas from the flight crew area. This pressurized bulkhead would ensure that any laser emissions would not penetrate the inhabited portion of the aircraft. Chemicals could also be jettisoned to minimize the amount released inside the aircraft.

Flight test activities would be configured so that reflected lasers would be contained within range boundaries. Exposure to a reflected laser beam would likely be very short, less than 0.01 seconds in duration and would not impact health and safety. (U.S. Air Force, 1997a, as referenced in MDA, 2003a)

Noise

Land and Sea Operating Environments

Laser activation activities would produce the same noise levels in all of the biomes considered in this PEIS. The potential for impact would depend on the specific operating location. Operation of equipment to support tests of lasers on land and sea operating environments would last for less than five minutes for each test. (U.S. Department of the Air Force, 1997b) The public and on-site personnel would be excluded from the area where the noise from this equipment would be detrimental. The size of this exclusion area would be determined using OSHA limit for noise exposure.

High noise levels between 110 and 134 dBA are associated with the pressure recovery system during activation of the laser. All personnel who could be affected would be evacuated from the area for their protection or required to wear appropriate hearing protection.

Air Operating Environment

Activation of the laser on an air platform would take place at an altitude of approximately 12,192 meters (40,000 feet), and noise resulting from this activation would not affect ground level noise.

Transportation

Land and Sea Operating Environments

Air traffic is the transportation mode that might be affected by the activation of lasers. The use of lasers from land and sea platforms has the potential to impact the use of airspace if the laser beam were directed upwards.

Air Operating Environment

The use of lasers from air platforms could also impact the use of airspace. The impacts on airspace are discussed above. These impacts would be the same in all of the biomes considered in this PEIS.

Water Resources

Land Operating Environment

Chlorine released by the operation of the COIL would react with water vapor in the atmosphere to produce hydrochloric acid. Hydrochloric acid absorbed by surface waters would cause a temporary pH change such that any alteration of the water's pH would be almost imperceptible. (U.S. Department of the Air Force, 1997b)

In areas where precipitation is heavy, catchment basins are small, and stream gradients are steep hydrochloric acid would pass quickly out of stream drainages. (FAA, 1996) Ocean waters would not be significantly affected by changes in pH due to sea water's ability to readily neutralize acid.

Usually the chlorine exhaust cloud would be highly dispersed before coming into contact with surface waters and would become dilute hydrochloric acid upon mixing with water. Under rainy or humid conditions, chlorine could be concentrated spatially or locally in nearby ground and surface water sources. This could occur in the Arctic Tundra, Sub-Arctic Taiga, Deciduous Forest, and Mountain Biomes. In addition, hydrochloric acid could be produced in the Sub-Arctic Taiga, Chaparral, Savanna, and Grasslands Biomes when cool and humid conditions exist during laser activation activities. The strong winds in the BOA would support the rapid dispersion of emissions. Given the dry conditions in the Desert Biome it is unlikely that chlorine would be converted to hydrochloric acid. The Tropical Biome is generally humid but the temperatures do not cool enough to convert the chlorine produced as a result of laser activation to hydrochloric acid.

Hydrochloric acid deposition in surface waters may cause temporary increases in water acidity. Once deposited, hydrochloric acid would be diluted and dispersed by the receiving waters. Therefore, hydrochloric acid emissions would have minimal impacts on water pH levels and would not be considered harmful.

Sources of potential ground water contamination are spills of cooling water or stored chemicals and/or leaks from the chemical waste and sludge tanks. Accidental releases of spent laser chemicals would be contained in accordance with site-specific spill plans that minimize impacts on water resources.

In the case of an accidental fire, liquid and solid laser chemicals would either be consumed or contained. Chemicals consumed by the fire would be released as gases and would not impact water resources. Remaining laser chemicals would be contained by spill prevention and control measures, and would be removed and disposed in accordance with standard procedures.

Ground testing of ABLs would use vacuum and scrubbing equipment that would result in hazardous wastewater that would need to be treated and disposed in accordance with applicable regulations.

Air Operating Environment

Activation of lasers from an air platform would occur at an altitude of approximately 12,192 meters (40,000 feet), which is higher than the mixing height. Emissions would be dispersed by wind and diluted in the atmosphere and would not impact surface water resources.

Sea Operating Environment

Impacts from laser activation during sea-based operations would be similar to those described above for land operations. The addition of hydrochloric acid to the ocean from the operation of the COIL would cause a slight increase in acidity of waters in the immediate vicinity of the contact point. However, saltwater tends to readily neutralize acid and the continual movement of waves further disperses and dilutes the chemicals. Therefore, significant acidification would not occur in the ocean.

4.1.1.2 Weapons - Interceptor*s*

As described in Exhibit 4-3, the analysis for interceptors is based upon impacts from prelaunch, launch/flight, and postlaunch activities.

Air Quality

Prelaunch Activities

For pre-fueled liquid propellant boosters and solid propellant boosters, prelaunch activities, such as elevating the booster to the launch angle and attaching fins to the booster, would not significantly impact air quality in any of the biomes considered in this PEIS.

For non-pre-fueled liquid propellant boosters, the prelaunch activity with the greatest potential for air quality impacts is fueling. All fueling procedures would need to be approved by the site where the activity is to occur, and associated emergency response plans would need to be reviewed before beginning fueling activities. Although total oxidizer and fuel vapor emissions would vary depending on the propellant transfer equipment used and how it is assembled, it is anticipated that only very small amounts (approximately 10 grams [0.4 ounces]) of oxidizer vapors would be released to the atmosphere during the oxidizer transfer operation. A negligible amount of fuel vapors

would also be released into the atmosphere during fuel transfers. (U.S. Army Space and Missile Defense Command, 2002c)

Propellant releases, although unlikely, could occur during propellant loading or transfer due to failure of transfer equipment or valves. An analysis conducted for the *Liquid Propellant Targets Environmental Assessment* (2002) assumed a leak over a three-minute period would release up to 17 liters (4.5 gallons) of oxidizer inhibited red fuming nitric acid (IRFNA), hydrogen peroxide, or nitrogen tetroxide, or hydrazine fuel.

Boosters could be shipped to the test range with the kill vehicle attached, or the booster could be shipped separately from the kill vehicle. In either case, the fuel and oxidizer tanks would be installed in the kill vehicle at the test site. If the booster is shipped separately from the kill vehicle, the kill vehicle would be mated to the booster in a missile assembly building. These structures are commonly used for these types of activities, and no impacts to air quality would be expected from the mating and assembly process. (U.S. Army Space and Missile Defense Command, 2003)

Launch/Flight Activities

Launches of pre-fueled liquid propellant boosters would use a solid propellant gas generator as the ignition source. This solid propellant gas generator would have emissions similar to those discussed for solid propellant boosters; however, the quantities involved would be significantly smaller. The primary exhaust products of pre-fueled liquid propellant boosters are water, H_2, N_2, hydrogen fluoride, CO_2, and CO.

Emissions from the launch of pre-fueled liquid propellant boosters would have minimal impact on air quality. (Cortez III Environmental, 1996) The only HAPs produced from launches of these missiles would be from the solid propellant gas generator, which would produce approximately 0.05 kilograms (0.10 pounds) of hydrochloric acid per launch, which is much less than the Clean Air Act regulatory reporting requirement of nine metric tons (10 tons) per year. (U.S. Department of the Air Force, 1997b)

Launches of non-pre-fueled liquid propellant boosters would be started by using triethylamine and dimethylaniline as an initiator fuel. The initiator fuel would have emissions similar to those discussed for the primary exhaust products for liquid propellants. The primary exhaust products of non-pre-fueled liquid propellant boosters are CO, CO_2, H_2, N_2, and water. Emissions from the launch of non-pre-fueled liquid propellant boosters would have minimal impact on air quality.

The primary exhaust products of solid propellant boosters are HCl, CO, NO_X, and aluminum oxide (Al_2O_3). HCl and CO emissions are gases and Al_2O_3 is emitted as particulate. CO and NO_X emissions are further oxidized to CO_2 and NO_2 due to the high temperatures experienced during launch; however, the quantities released from a single

test event are not expected to contribute to localized accumulation of greenhouse gases. Gaseous HCl produced by launches of solid propellant boosters combines with water in the atmosphere to create hydrochloric acid aerosol, which may contribute to the formation of acid rain. This is a particular concern in high precipitation areas or humid biomes where moisture in the air could aid the conversion of HCl to hydrochloric acid. Several biomes including Arctic Tundra, Sub-Arctic Taiga, Deciduous Forest, and Mountain Biomes are considered humid. In addition, acid precipitation could be produced in the Sub-Arctic Taiga, Chaparral, and Grasslands Biomes when cool and humid conditions exist during launch activities.

As the booster proceeds through the layers of the atmosphere the impact of emissions from launch/flight activities varies depending on the propellant system used. One emission of concern produced by some liquid propellant boosters is CO, which can cause radiative heating and minor chemical reactions when emitted in the stratosphere.

Launch/flight activities can contribute to global warming through the emission of greenhouse gases. These emissions could include water vapor and CO_2. However, launch/flight activities would not contribute significantly to the total emissions of these gases, and so would not have a significant effect.

Within the stratosphere, ozone depletion is a primary concern. Ozone in the stratosphere provides a protective layer shielding the Earth from ultraviolet radiation and subsequent harmful effects. Ozone may be depleted through complex reactions with chlorine, Al_2O_3, and NO_X.

Solid propellant boosters emit HCl through high temperature afterburning reactions in the exhaust plume, which could partially be converted to atomic chlorine and molecular chlorine (Cl and Cl_2). These active forms of chlorine can contribute to localized ozone depletion in the wake of the booster. The USAF atmospheric interceptor technology (*ait)* vehicle may be representative of solid propellant boosters that would be used as part of the BMDS. The *ait* would spend approximately 25 seconds in the stratosphere at an altitude between 15 and 40 kilometers (9 and 25 miles). The first stage of the *ait* would deposit approximately 181 kilograms (400 pounds) of HCl and approximately 249 kilograms (550 pounds) of combined Cl and Cl_2 between an altitude of 15 kilometers (9 miles) and 34.6 kilometers (21.5 miles). This represents less than 14 kilograms (30 pounds) of active chlorine being distributed per kilometer of altitude traveled by the test vehicle. The second stage of the *ait* would contribute a total of approximately 3 kilograms (6 pounds) of HCl, Cl, and Cl_2 between ignition and 40 kilometers (25 miles) altitude. It is estimated that less than one pound per kilometer of altitude of the active forms of chlorine would be emitted by the second stage. Due to the large air volume over which these emissions would be spread, and because of rapid dispersion by stratospheric winds, the active chlorine from launches would not contribute to significant localized ozone depletion.

The emission of Al_2O_3 has been the subject of study with respect to ozone depletion. Al_2O_3 is emitted as solid particulates that may serve as sites for atmospheric chemical reactions. The studies (Molina, 1996, as referenced in U.S. Department of the Air Force, 1997a) indicate that Al_2O_3 can activate chlorine. The exact magnitude of ozone depletion that can result from a build-up of Al_2O_3 over time has not yet been determined quantitatively, but appears to be insignificant based on existing analysis.

Exhaust from the first stage of the USAF *ait* vehicle is approximately 27 percent by weight Al_2O_3, and the second stage exhaust is 35.4 percent Al_2O_3 by weight. The total amount of Al_2O_3 deposited between an altitude of 15 and 40 kilometers (9 and 25 miles) by each USAF *ait* flight is approximately 535 kilograms (1,180 pounds) from the first stage and 38 kilograms (83 pounds) from the second stage. The Al_2O_3 emitted during *ait* flight is in the form of smooth particles with sizes varying in diameter from less than one micron to ten microns. (Beiting, 1997, as referenced in U.S. Department of the Air Force, 1997a) Depending on the altitude where these particles are emitted, they may diffuse out of the stratosphere over a period of weeks to a few years. The particles would participate in reactions that may cause ozone depletion during the time that they stay in the stratosphere. (Molina, 1996 and Jackman, 1996, as referenced in U.S. Department of the Air Force, 1997a) The Al_2O_3 solid particles would have the potential to contribute to ozone-depleting reactions while in the stratosphere but because of the large air volume in the stratosphere and rapid mixing, they would not cause significant localized effects on stratospheric ozone depletion.

NO_X is produced during high temperature reactions known as afterburning in the exhaust plume of solid propellant boosters. As the temperature of the exhaust decreases with increasing altitude, less NO_X is formed. For the USAF *ait*, the first stage afterburning production of NO_X is nearly stopped before the vehicle reaches the stratosphere. The total NO_X deposited in the stratosphere is approximately two kilograms (four pounds) from the USAF *ait* first stage and less than 0.5 kilograms (one pound) from the second stage. Stratospheric winds would disperse these quantities rapidly; therefore, no significant effect on ozone depletion would be expected from these emissions. (Molina, 1996, as referenced in U.S. Department of the Air Force, 1997a)

Land and Sea Operating Environments. Because the booster is moving away from the point of launch, only a small portion of the launch exhaust would be emitted near the launch area. In general, biomes with moderate to high winds experience less concentration of air emissions because the winds tend to disperse the ground level emissions. These biomes may include: Deciduous Forest, Chaparral, Desert Biomes, and the BOA. Other biomes including the Arctic Tundra, Sub-Arctic Taiga, Grasslands, Tropical, Mountain, and Savanna may experience higher localized concentrations of air emissions although this would depend on the site-specific conditions.

Launch activities would not be expected to bring any new stationary emission sources to the launch area; therefore, new permits or changes to existing air permits would not be required. If new stationary emission sources were introduced into the region, it is possible that additional permits or changes to existing air quality permits would be required.

Kill vehicles could use either solid or liquid propellants. The liquid propellants likely to be used on the kill vehicle are hypergolic propellants, which would be used in small quantities. Because the launch/flight of kill vehicles is not initiated until the vehicle is high above the Earth's surface, emissions released from the kill vehicle would occur above the troposphere (10 kilometers [6.2 miles]) and therefore, would not impact ground-level air quality.

Air Operating Environment. Launches of pre-fueled and non-pre-fueled liquid and solid propellant boosters from air-based platforms would have less impact on ground-level air quality than launches from land or sea platforms because these launches would produce air emissions at a higher altitude. Using this type of operating environment, the rocket motor would be ignited at an altitude from 1.5 to 6 kilometers (0.93 to 3.7 miles). At this altitude, the booster would be ignited in the troposphere (extending to 10 kilometers [6.2 miles] above the surface of the Earth). Pollutants above the troposphere (and therefore, above the mixing layer) do not significantly impact ground-level air quality. The mixing layer allows for vertical "stirring" of air masses, which aids in the dilution of pollutants before they are slowly transported to ground level.

Postlaunch Activities

The impacts of postlaunch activities have been separated into two discussions below – one for air quality impacts when launch debris or residual propellants hit land and the other when these fall into water.

Launch Debris Hitting Land. The amount of residual propellant in the booster when it hits the ground would depend on several factors including how much propellant was in the booster at launch and how far the booster traveled during the mission. The amount of residual IRFNA in a pre-fueled liquid propellant booster could vary from 12 to 343 kilograms (26.5 to 756 pounds) and the amount of residual unsymmetrical dimethyl hydrazine could vary from 14 to 123 kilograms (31 to 271 pounds). A non-pre-fueled liquid propellant booster could impact the ground with approximately 265 liters (70 gallons) of fuel and approximately 473 liters (125 gallons) of oxidizer remaining. The residual propellants could burn upon impact, or one or both propellants could be released to the atmosphere without burning. (Cortez III Environmental, 1996)

If the propellants burn upon impact, short-term impacts to air quality would occur. The ground-based booster impact areas would be isolated from inhabited areas and would be

evacuated prior to a launch; therefore, any exceedances of the NAAQS or exceedances of health-based criteria would not endanger the public. The remote location of the impact area would allow time and distance sufficient to disperse fumes to a non-hazardous level. It is not anticipated that combustion of the propellant(s) would result in air quality impacts beyond the immediate impact site.

If the residual propellants were released to the atmosphere without burning, the IRFNA is likely to be volatilized as NO_X and nitric acid. Observations of launches of pre-fueled liquid propellant boosters at WSMR indicate that a brown cloud has been observed immediately after impact. (Wilson, 1999, as referenced in Cortez III Environmental, 1996) This cloud is likely produced by IRFNA converting to NO_X, which can induce severe irritation to the eyes, skin, and mucous membranes and can lead to suffocation. Unsymmetrical dimethyl hydrazine is a known carcinogen that can react with oxygen and release toxic fumes of NO_X if released to the air without combusting. These releases have been studied to dissipate below hazardous levels within 24 hours and to be undetectable after a period of six months. (Wilson, 1991, as referenced in Cortez III Environmental, 1996) Hydrogen peroxide and hydrocarbons would dissipate when exposed to air. Nitrogen tetroxide if released to the air without combusting would be converted to gaseous form.

Residual propellant from solid propellant boosters would likely continue to burn until expended if encased; however, if released from the motor casing, it is possible that solid propellant would not burn completely. This combustion would have a minor impact on air quality. There is a possibility that the burning solid propellant if encased could start a fire on the ground. The resulting fire could impact air quality in the area immediately surrounding the impact area.

During a mission involving a successful intercept, the kill vehicle would be destroyed and small pieces of debris would impact the Earth's surface. The small pieces of debris may temporarily serve as sites for chemical reactions in the Earth's atmosphere until the debris reaches the ground. However, the impacts to air quality would be minimal.

If the propellants in the kill vehicle were released to the atmosphere in an impact, they would either burn up, or one or both propellants could be released to the atmosphere and evaporate. Impacts from either scenario would be similar to those discussed above for propellants released from liquid propellant boosters.

Launch Debris Hitting Water. The impacts to air quality from postlaunch activities resulting in boosters and kill vehicles hitting the ocean would be similar to, but less than those impacts discussed above for boosters and kill vehicles hitting land because the residual liquid propellants would be released into the ocean rather than the air. Impacts to water quality from a direct release to water are described in the hazardous waste

section. Solid propellant, if still in the casing, might continue to burn for some time even under water. However, this would create minimal impacts to air quality.

Airspace

Prelaunch Activities

There would be no impact on airspace from prelaunch activities, including, fueling, evacuations and clearances, and road closures, because these activities do not physically interfere with navigable airspace or affect airspace scheduling.

Launch/Flight Activities

Close coordination with the appropriate FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impacts on airspace use and scheduling for launches from all operating environments in all of the biomes considered in this PEIS. Launches of boosters and kill vehicles would require coordination with current aeronautics and space activities within the airspace associated with launch sites. Launch, flight, and impact of boosters and kill vehicles would occur in designated areas of cleared airspace.

Land Operating Environment. Although launches of interceptors might require closure of some airspace and would, therefore, impact the amount of available airspace, this type of activity is considered routine at many military installations and would not constitute a significant impact. Aircraft transiting the area would be notified of any necessary rerouting requirements before departing their originating airport and would thus be able to take on any additional fuel before takeoff to avoid the affected area. Launches would be scheduled such that they would not affect airborne activities outside the airspace complex(es) where they are to occur, and would not interfere with any low- or high-altitude en route airways or jet routes use by civilian or private airports in the vicinity of the launch site.

In addition, before conducting an operation that is potentially hazardous to non-participating aircraft, Notices to Airmen (NOTAMs) would be established in accordance with range safety procedures. To satisfy airspace safety requirements, the responsible official would obtain approval from the FAA, prior to conducting the launch. Provisions also would be made for surveillance of the affected airspace by radar and patrol aircraft prior to booster launch. Safety regulations dictate that hazardous operations are suspended when any non-participating aircraft enters any part of the hazard area. Operations would resume when the non-participating entrant has left the area or a thorough check of the suspected area has been performed. For these reasons, no adverse impacts to airspace are expected from ground launches.

Air Operating Environment. Within minutes after launch, the booster would be propelled to an altitude of several hundred thousand feet, well above the typical altitudes used by commercial aircraft. The launches, flight trajectory, and ground impacts would occur at sufficient distance and altitude to be virtually unnoticed by local, non-military flying activities. Other impacts to airspace from launches of boosters from air operating environments would be as described for launches from land operating environments.

Sea Operating Environment. Potential impacts to airspace from launches of boosters from sea platforms would be minimized by coordination between airspace complexes. Procedures would be similar to those for launches from land and air operating environments. If the sea operating environment were positioned in the BOA, potential impacts would be further minimized because airspace over the BOA is not heavily used.

Establishing restricted areas would marginally reduce the amount of navigable airspace in the BOA, but because the airspace is not heavily used, the impacts to controlled and uncontrolled airspace would be minimal. If possible, the sea environment would be positioned to avoid the en route airways and jet routes that cross the BOA. Therefore, no significant impacts to the over-water airways and jet routes would be expected from any type of missile launched from a sea operating environment.

Postlaunch Activities

Impacts of postlaunch activities on airspace are discussed below addressing postlaunch debris recovery on land and in water.

Launch Debris on Land. If necessary, helicopter retrieval of debris, from boosters or kill vehicles deposited on land would be within the boundaries of the designated impact area and therefore, within the airspace complex. Debris retrieval would have no impact on navigable airspace or airborne activities outside the restricted airspace complex.

Launch Debris in Water. If debris from boosters or kill vehicles falls into water, MDA would not likely recover the debris. Therefore, helicopters and other equipment would not be used, and no impacts to airspace would be expected. If it were necessary to recover debris from water for a specific test, the impacts of debris retrieval would be analyzed as appropriate.

Biological Resources

Prelaunch Activities

There would be no impacts to biological resources from prelaunch activities for pre-fueled and solid propellant boosters and kill vehicles. For non-pre-fueled liquid propellant boosters, no more than a few grams of propellant would be released during

normal fueling operations and appropriate responses to leaks and releases would be implemented to minimize the hazard to biological resources. All fueling would be conducted using impermeable barriers appropriate for this type of activity, which would minimize the potential for a spill to impact biological resources.

Launch/Flight Activities

The presence of launch-related personnel prior to launch, noise associated with launch, and launch emissions all have the potential to impact biological resources during launch.

Informal observation at several launch facilities indicates that the increased presence of personnel immediately before a launch tends to cause birds and other mobile species of wildlife to temporarily leave the area prior to the launch. This would effectively reduce the effects of sound, launch emissions, and heat on these animals. However, personnel associated with the launch would comply with USFWS, other regulatory agency, and relevant site-specific procedures to protect biological resources including species of special concern.

The effects of noise on wildlife can be categorized as either auditory or non-auditory. Auditory effects would consist of direct physical changes, such as eardrum rupture or temporary threshold shift (temporary hearing loss). Non-auditory effects could include stress, behavioral changes, and interference with mating or foraging success. The effects of noise on wildlife vary from serious to no effect in different species and situations. Animals can also be sensitive to noises in some situations and insensitive to the same noises in other situations. (Larkin, 1996) Behavioral responses to noise also vary from startling to retreat from favorable habitat.

Launches would be relatively infrequent events. Disturbance to wildlife would be brief and would not be expected to have a lasting impact nor a measurable negative effect on migratory bird populations. Wildlife would resume feeding and other normal behavior patterns after a launch is completed. Specifically, a 1982 study by Stewart found that birds exposed to 115.6 to 145.5 dBA short intensity noise events returned to their nests within 2 to 10 minutes after the disturbance. (Stewart, 1982, as referenced in Manci, et al., 1988) In addition, a 1980 study by Jehl and Cooper used shotgun blasts and explosives to simulate short duration noise events and found that nesting birds returned within 30 seconds of the disturbance. (Jehl, J.R and C.F. Cooper, 1980, as referenced in Manci et al, 1988) Wildlife driven from preferred feeding areas by aircraft or explosions usually return soon after the disturbance stops, as long as the disturbance is not severe or repeated. (FAA, 1996) Foraging birds would be subjected to increased energy demands if flushed by the noise, but this should be a short-term, minimal effect.

Video camera observations of a wood stork colony located 0.8 kilometer (0.5 mile) south of the Space Shuttle launch pad at Kennedy Space Center showed the birds flew south

away from the noise source and started returning within two minutes, with a majority of individuals returning in six minutes. (NASA, 1997, as referenced in U.S. Army Space and Missile Defense Command, 2002c) This rookery continues to be used successfully, even though it has received peak noise levels of up to 138 dB. (American Institute of Aeronautics and Astronautics, 1993, as referenced in U.S. Army Space and Missile Defense Command, 2002c) Birds roosting within 250 meters (820 feet) of Titan launch complexes at Cape Canaveral Air Force Station have shown no mortality or reduction in habitat use.

Fixed wing aircraft and helicopters are often used for routine flights around the Arctic Tundra Biome. These aircraft noises have been shown to produce sounds that are disturbing to seabirds. (Fjeld et al., as referenced in Chardine and Mendenhall, 2003) Breeding murres and eiders appear to be sensitive to this type of disturbance. Murres do not build nests but rather incubate their eggs on their feet; therefore, overflight noises may produce panic flights, leading to egg loss.

During breeding and nesting periods birds may be less likely to flush from their nests for long periods of time. Monitoring studies of birds during the breeding season indicate that adults respond to Space Shuttle noise by flying away from the nest, but they return within two to four minutes.

Noise associated with launches may disrupt critical nesting and migratory points for birds in the Deciduous Forest and Chaparral Biomes, which are common migration corridors for many species. Efforts at reducing noise interference are already underway to protect the endangered Red-Cockaded Woodpecker in the Southeast U.S., where it is estimated that nearly a quarter of the remaining Red-Cockaded Woodpecker population resides on 16 military installations. (Delaney et al., 2002) Birds located in other biomes may also be impacted by launch activities and the extent of impact would be determined based on site-specific considerations.

Noise level thresholds for impact to marine life in general and marine mammals in particular, are currently the subjects of scientific studies. Because different species of marine mammals have varying sensitivities to different sound frequencies, and the species may be found at different locations and depths in the ocean, it is difficult to generalize sound impacts to marine mammals from booster launches. Should consensus emerge from scientific analyses about the effects of noise on underwater marine mammals, it would be possible to predict the consequences of particular sonic boom contours on marine mammals in the area.

According to analysis provided in the U.S. Navy's *Point Mugu Sea Range Environmental Impact Statement (EIS)/Overseas EIS* (2002), brief transient sounds such as sonic booms are unlikely to result in significant adverse effects to pinnipeds or whales in the water. Pinnipeds seem tolerant of noise pulses from sonic booms, although reactions may occur.

Temporary displacement, less than one or two days, is considered a less than significant impact. Baleen whales (humpback, gray, and bowhead) have often been observed behaving normally in the presence of loud noises, such as distant explosions and seismic vessels. Most gray and bowhead whales show some avoidance of areas where these noises have pressures exceeding 170 dB. (U.S. Department of the Navy, 2002, as referenced in U.S. Army Space and Missile Defense Command, 2003)

Launch emissions from pre-fueled and non-pre-fueled liquid propellant boosters would have the potential to impact biological resources, but the impact would be minimal. HCl and Al_2O_3 emitted during launches of solid propellant boosters can harm plants and wildlife. Studies indicate that low-level, short-term exposure to HCl, as would be the case in booster launches, would not cause significant damage to vegetation or wildlife. Animals and birds passing through the exhaust plume may be exposed to levels of HCl that would irritate their eyes and respiratory systems. (FAA, 1996, as referenced in U.S. Army Space and Missile Defense Command, 2002a) Al_2O_3 has a very low toxic potential. HCl and Al_2O_3 do not bioaccumulate; and therefore, no effects on the food chain would be expected. Surface water including wetlands could be impacted by the presence of hydrochloric acid, which could lower the pH and have a negative effect on species relying on the wetlands.

Land Operating Environment. Launch activities from land-based operations that take place in previously disturbed areas would not be expected to adversely affect plant species. Launch areas are typically cleared of all vegetation and either covered with a layer of course gravel or left bare. (Cortez III Environmental, 1996) However, fire from a launch mishap at the launch site could impact plant species that may be present. Any fire would be extinguished quickly, where possible, minimizing impacts to vegetation remaining in the area. The risk of fires from launch activities is particularly prevalent in the Chaparral and Tropical Biomes, which are prone to wildfires.

Sea Operating Environment. Pollutants would be present in the exhaust plume from boosters launched from sea platforms that could threaten wildlife near the point of the sea launch. However, these pollutants would be produced in trace quantities and would not have measurable effects on biological resources.

Postlaunch Activities

Impacts of launch debris on biological resources are discussed below on land versus those impacts of debris falling into water.

Launch Debris Hitting Land. The amount of ground disturbed for each booster or kill vehicle impact would be less than 0.2 hectares (0.5 acres). (U.S. Army Space and Missile Defense Command, 2002c) Restoration of impact sites that are currently used for booster or kill vehicle impacts, if deemed necessary, would be conducted on a case-by-case basis

in coordination with the appropriate officials. Because threatened and endangered plant and animal species tend to be widely scattered and occupy small surface areas, the probability of a booster striking an individual of a federally listed, threatened, or endangered species is remote.

New impact areas for boosters or kill vehicles could be created for specific missions. Selection of a new impact area would be coordinated with the appropriate range personnel to avoid or minimize potential harm to protected species. Effects to biological resources from impacts on a new area would be similar to those described above for impacts on existing areas.

Recovery of booster and kill vehicle debris, if required, would be conducted in accordance with the launch site's existing procedures. These procedures outline steps to be taken to avoid known sensitive areas. Off-road vehicle recovery operations would be used only if necessary and would be coordinated with the appropriate responsible officials. Recovery by vehicle would be limited to the minimum number of vehicles necessary to complete the operation. If necessary, light-lift helicopters could be used to recover debris in rough terrain. Aircraft, particularly helicopters, are loud and produce sounds that might disturb wildlife. Low altitude helicopter flights, which are known to cause panicky reactions in some wildlife species, would be intermittent, would involve gradual descents when necessary, and would then return to altitudes that would avoid further startling effects.

In the unlikely event of flight termination or catastrophic missile failure, the impact of debris on land areas may damage vegetation and wildlife. In the case of flight termination or missile failure, debris and residual propellant could result in a fire that could damage vegetation and wildlife. However, impact areas would generally be cleared of vegetation, minimizing the potential for impact to biological resources due to fires. Hazardous debris, if any, would be recovered as quickly as possible.

Launch Debris Hitting Water. Debris falling into water has the potential to cause non-acoustic effects to biological resources. These effects include physical impact by falling debris, entanglement in debris, and contact with or ingestion of debris or propellants.

Boosters hitting the ocean surface would impart a considerable amount of kinetic energy to the ocean water upon impact. Interceptors would hit the water with speeds of 91 to 914 meters (300 to 3,000 feet) per second. The shock wave from their impact with the water would be similar to that produced by explosives. Depending on the water depth, strong waves from the impact may detach kelp strands from the sea floor. During successful missions, boosters would impact in the deep open ocean waters. At close ranges, injuries to marine mammal internal organs and tissues would likely result.

However, the density of marine species including marine mammals generally decreases, and the corresponding probability of impact decreases, as the distance from the shore increases. Injury to any marine mammal by direct impact or shock wave impact would be extremely remote (less than 0.0006 (6 in 10,000) marine mammals exposed per year). (U.S. Department of the Navy, 2002b)

Impacts to marine biological resources from releases of residual propellants from liquid propellant boosters would not be significant. The natural buffering capacity of sea water and the strong ocean currents would neutralize the reaction to any release of the liquid propellants. Impacts to water quality from a direct release to water are described in the hazardous waste section.

The parts of solid rocket motor propellant expelled from a destroyed or exploded rocket motor that fall into the ocean would most likely sink to the ocean floor at depths of thousands of meters. At such depths, the propellant parts would be located away from feeding marine mammals. (U.S. Department of the Navy, 1998 as referenced in U.S. Army Space and Missile Defense Command, 2003) Therefore, marine animals would not be impacted from ingesting the solid propellant.

Geology and Soils

Prelaunch Activities

There would be no impacts to geology and soils from prelaunch activities for pre-fueled liquid and solid propellant boosters. Fueling of non-pre-fueled liquid propellant boosters would be conducted using appropriate impermeable barriers. (U.S. Army Space and Missile Defense Command, 2002c) Adherence to these procedures would minimize the potential for spills and any impacts to soils.

Launch/Flight Activities

Impacts to geology and soils are discussed separately below for land, sea and air operating environments.

Land Operating Environment. Potential geology and soils impacts from ground launches would be minor. Emissions that occur above the mixing height or above the troposphere would not affect geology and soils.

Soils that are strongly leached (removed of nutrients, including calcium) and are therefore acidic could be adversely affected by the addition of hydrochloric acid produced when HCl interacts with water in humid biomes further increasing soil acidity. This could occur in the Arctic Tundra, Sub-Arctic Taiga, Savanna, Mountain and parts of the Deciduous Forest, and Tropical Biomes.

The intensity of the acidic effect is a function of the amount of calcium carbonate in the soils. Calcium carbonate in some soils including those in the Grasslands and Deciduous Forest and some limestone rich portions of the Tropical Biome have nearly unlimited buffering capacities and would likely prevent emissions produced from solid boosters from affecting geology and soils. (EPA, 2003g) Therefore, no significant impacts to geology and soils would be expected.

The Chaparral and Desert Biomes are unlikely to produce hydrochloric acid as a result of launches of solid propellant boosters and therefore soils in these biomes are unlikely to be affected by increased acid deposition. Although overall impacts to geology and soils from launch activities are expected to be minor, in areas where launches have not previously occurred, such as the U.S. Mountain Biome, the exhaust ground cloud could impact areas not previously disturbed by launch activities. The specific impacts to these areas would need to be analyzed as appropriate.

Air Operating Environment. Impacts to geology and soils from air-based launches would be minor because ignition of the booster would occur several thousand feet above ground level. Emissions from air launches of boosters would have a smaller effect on geology and soil resources than land launches because the emissions would be at a greater altitude and would, therefore, be subject to greater dispersion and dilution prior to reaching the ground.

Sea Operating Environment. No impacts to geology and soils would be expected from launches from sea-based platforms due to the depth of the ocean in areas from which sea launches would operate.

Postlaunch Activities

Impacts to geology and soils from launch debris hitting land versus falling into water are discussed separately below.

Launch Debris Hitting Land. The debris from boosters and kill vehicles could physically impact the ground surface and overlying soils, but there would be no impact expected on geologic resources. Land surface damage from debris would be variable and determined by impact energy, soil compressibility, presence of water, and altitude from which the debris fell. (U.S. Army WSMR, 1998) The impact of the debris may result in ground depressions up to six meters (20 feet) deep. The extent of immediate physical disturbance to the soil from debris impact is likely to be less than 0.2 hectares (0.5 acres).

Debris recovery, if required, would be limited to necessary vehicles and off-road access would follow the same entry route, to the extent possible, to complete the recovery operations with minimal disturbance to soils. (U.S. Army WSMR, 1998)

Residual propellants may be released upon booster or kill vehicle impact. If the propellants burn on impact, fire containment activities could also cause minor impacts to the soil. If vegetation were damaged, then wind and water erosion could both increase.

If the residual IRFNA or unsymmetrical dimethyl hydrazine in a pre-fueled liquid propellant booster do not explode or burn at impact, then they would most likely be deposited on the ground. The IRFNA would volatilize into the atmosphere. Hydrazine fuel would slowly dissipate from surface soils within 24 hours. Hydrazine fuels buried in an impact crater created by the debris would dissipate over several months and would not significantly impact geology or soils. (Cortez III Environmental, 1996)

If the residual propellants from non-pre-fueled liquid propellant boosters do not explode or burn at impact, then they would most likely be deposited on the ground. The nitrogen tetroxide oxidizer would volatilize into the atmosphere. Any residual nitric acid would react with alkaline soils resulting in the deposition of nitrates that would act as a fertilizer and would not appreciably affect soils. Hydrogen peroxide oxidizer deposited on the ground would decompose into water and oxygen within several hours. Kerosene or JP-8 fuel deposited on the ground would be absorbed by the soil. Personnel at the debris impact site would follow standard operating procedures to determine whether soil remediation or removal and treatment and disposal actions are required.

Launch Debris Hitting Water. No impacts to geology and soils would be expected from debris falling into the ocean due to the depth of the ocean where debris would impact. Inert pieces of debris would be deposited in the ocean and would consist of aluminum, steel, graphite composite, plastic, ceramic, and rubber. These materials would likely sink to the ocean floor; however, they would be unlikely to impact geology and soils in ocean areas.

Hazardous Materials and Hazardous Waste

Prelaunch Activities

The types of hazardous materials used and waste generated during prelaunch, launch/flight, and postlaunch activities would be similar to those currently used and generated at military installations. Accidental releases of hazardous materials would be contained in accordance with site-specific spill plans. Temporary storage tanks and other facilities for the storage of hazardous materials would be located in protected and controlled areas. Activities would be conducted to comply with site-specific spill prevention, control and countermeasure (SPCC) plans, such as an Oil Discharge Prevention and Contingency Plan and a Storm Water Pollution Prevention Plan (SWPPP). (U.S. Army Space and Missile Defense Command, 2002d) Any spill of a hazardous material or hazardous waste that might occur could be quickly remediated in

accordance with a Storm Water Pollution Prevention Plan and SPCC plan that would be developed for each site.

Should it become necessary to remove the propellants from a pre-fueled liquid propellant booster, the propellant would be drained into empty bulk liquid propellant containers stored at the fueling location. (U.S. Army Space and Missile Defense Command, 2002c) The defueled oxidizer tank would be flushed with deionized water, and the fuel tank would be flushed with ethyl alcohol. The booster would be transported back to the missile assembly building for reuse or returned to an appropriate facility. Emergency response planning would be incorporated into the operations requirements to minimize any impacts due to an unplanned release of hazardous materials. Therefore, no significant impacts would be expected.

Non-pre-fueled liquid propellant boosters could be fueled at the launch location, provided there is sufficient space, or at a fixed, permanent facility. Fuel and oxidizer would be transported separately to the loading location and loaded at different times. Spill containment for the propellant transfer operation could be provided by a temporary containment system that is impervious to each particular fuel and oxidizer. One set of temporary containment barriers would be used for fuel, and a second set would be used for oxidizer. (U.S. Army Space and Missile Defense Command, 2002c) After completion of the transfer operations, the transfer equipment would be flushed to decontaminate it. Flushing the fuel transfer system would generate approximately 208 liters (55 gallons) of ethyl alcohol with approximately 40 grams (1.4 ounces) of fuel in solution. Flushing the oxidizer transfer system with deionized water would generate approximately 4,164 liters (1,100 gallons) of neutralized deionized water and oxidizer rinsate (less then 1 percent) and would result in the release of approximately five grams (0.2 ounces) of nitric oxide to the atmosphere. The material generated from flushing the propellant transfer systems would be handled as hazardous waste and would be disposed via appropriate procedures using permitted disposal facilities. Although propellant quantities and fueling systems have not been defined for all non-pre-fueled liquid propellant boosters, it is anticipated that similar materials would be generated when flushing hydrogen peroxide oxidizer and hydrocarbon fuel. Flushing nitrogen tetroxide oxidizer would involve similar methods and materials generated as IRFNA.

Should it become necessary to remove the propellants from the non-pre-fueled liquid propellant booster, the propellant would be transferred into empty bulk liquid propellant containers stored at the fueling location. (U.S. Army Space and Missile Defense Command, 2002c) The propellant containers would then be transported to the respective propellant storage areas for reuse in the next mission. The defueled oxidizer tank would be flushed with deionized water and the fuel tank would be flushed with ethyl alcohol as described above. The booster would be transported back to the missile assembly building for reuse or returned to an appropriate facility.

The fuel and oxidizer tanks in kill vehicles would be installed at the test site. Spill containment and propellant removal procedures would be similar to those described above for non-pre-fueled liquid propellant boosters.

There would be no impacts from prelaunch activities for solid propellant boosters.

Launch/Flight Activities

Launch activities would produce the same hazardous materials and hazardous waste in all biomes considered in this PEIS. Launches would potentially increase the hazardous waste generated at the launch sites. However, this increase in hazardous waste would not overburden the various facilities' hazardous waste management programs, and only minimal impacts would be anticipated. During a nominal launch there would be no hazardous materials or hazardous waste impacts from the launch/flight of boosters or kill vehicles.

Postlaunch Activities

Impacts from hazardous materials and hazardous waste launch debris are addressed separately below on land versus in water.

Launch Debris on Land. Debris from boosters and kill vehicles and residual propellant would be handled in accordance with the appropriate spill contingency plan for the launch location/debris impact site. These plans establish responsibility, outline personnel duties, and provide resources and guidelines for use in the control, clean up, and response to spills.

Entry to the debris impact site would be restricted to trained hazardous material response personnel until the area is determined to be safe. All debris would be tested to determine if it is hazardous waste. Hazardous waste would be disposed via permitted procedures. For a nominal flight, liquid propellant boosters would contain unburned propellant upon impact within the planned impact area. The amount of propellant remaining in the booster would vary depending on the particular mission objectives (i.e., distance flown and fuel burned).

During nominal flights of solid propellant boosters, most of the solid propellant would be expended. Debris would include structural material and batteries. These materials would be inert and would not have any significant impacts. Flight termination or catastrophic failure of the booster would result in the deposition of structural material and battery debris and any residual propellant. Some of the potentially hazardous material contained in the batteries or propellants would likely be consumed during the termination or failure. It is not expected that the remaining debris would pose a significant impact.

<u>Launch Debris in Water</u>. NASA has conducted evaluations of the effects of missile systems deposited in sea waters. The studies determined that materials would be rapidly diluted, and except for areas in the immediate vicinity of the debris, would not be found at concentrations identified as causing any adverse effects. This applies to debris deposited either as a result of successful or unsuccessful intercepts, or due to in-flight malfunction or flight termination along the flight corridor. Eventually, all hazardous materials falling into the ocean would become diluted and would cease to be of concern. NASA determined that the release of hazardous materials aboard missiles into sea waters would not be significant. (NASA, 1973 as referenced in U.S. Army Space and Missile Defense Command, 2003) Therefore, no significant impacts to the ocean environment would be expected from postlaunch activities involving liquid propellant missiles.

During flight termination or catastrophic missile failure of solid propellant boosters, pieces of unburned propellant could be dispersed over an ocean area of up to several kilometers. Once in the water, ammonium perchlorate could slowly leach out and would be toxic to plants and animals. In freshwater at 20^{o}C (68^{o}F), it is likely to take over a year for the perchlorate contained in solid propellant to leach out into the water. (Lang et al., 2000, as referenced in U.S. Army Space and Missile Defense Command, 2003) Lower water temperatures and more saline waters would likely slow the leaching of perchlorate from the solid propellant into the water. Over this time, the perchlorate would be diluted in the water and would not reach significant concentrations. (U.S. Army Space and Missile Defense Command, 2003)

Health and Safety

Prelaunch Activities

The handling and assembly of booster components are typically accomplished within enclosed buildings. These activities would adhere to applicable laws and regulations including the Range Commanders Council Standard 321-02, which establishes limits for risk to human health and safety. These analyses would take into account installation-specific and test-specific safety tolerances (range hazard areas).

Prelaunch activities for pre-fueled liquid and solid propellant boosters would not have any impact on health and safety. All liquid propellant booster fueling procedures for non-pre-fueled liquid propellant boosters would be approved for the site where the activity is to occur, and associated emergency response plans would need to be reviewed before beginning activities to ensure protection of health and safety. Total oxidizer and fuel vapor emissions would vary depending on the propellant transfer equipment used and how it is assembled. It is anticipated that only very small amounts of oxidizer vapors would be released to the atmosphere during the oxidizer transfer operation. A negligible amount of fuel vapors would also be released into the atmosphere during fuel transfers. Exposure to liquid propellants resulting from fueling activities would be minimal. The

existing condition in several biomes would preclude fueling emissions from impacting health and safety of workers; this would be true in biomes where wind conditions would rapidly disperse emissions. Windy conditions are likely in the Sub-Arctic Tundra Biome.

Analysis conducted using the U.S. Air Force Toxic Corridor Model computer model indicated potential exceedances of health standards as shown in Exhibit 4-9. Actual hazard distances would depend on the propellant, the amount released, meteorological conditions, and emergency response measures taken. Standard operating procedures would be developed and would include personal protection equipment procedures and distances at which it would be safe to establish fueling operations area boundaries. Establishment of and adherence to these procedures would minimize the potential health and safety hazards to personnel in the unlikely event of an unplanned propellant release. The low likelihood of such an occurrence and the implementation of approved emergency response plans would limit the impact of such a release. People located at distances in excess of the exceedance distance would not be exposed to health and safety impacts from prelaunch fueling activities.

Exhibit 4-9. Potential Exceedances Due to Accidental Oxidizer or Fuel Leak to Air During Fueling Activities

Propellant	Health Standard	Standard Limit	Exceedance Distance
IRFNA	OSHA Permissible Exposure Limit (PEL)[a]	2 parts per million (ppm) (5 milligrams per cubic meter (mg/m^3))	34 meters (112 feet)
	National Institute for Occupational Safety and Health (NIOSH) Short Term Exposure Limit (STEL)[b]	4 ppm (10 mg/m^3)	20 meters (66 feet)
	Immediately Dangerous to Life and Health (IDLH)[c]	25 ppm (65.5 mg/m^3)	Not Exceeded
Hydrogen Peroxide	OSHA PEL	1 ppm (1.4 mg/m^3)	212 meters (696 feet)
	NIOSH STEL	1 ppm (1.4 mg/m^3)	212 meters (696 feet)
	IDLH	75 ppm (105 mg/m^3)	14 meters (46 feet)
Nitrogen Tetroxide	American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV)[d]	3 ppm (5.4 mg/m^3)	310 meters (1,017 feet)
	ACGIH STEL[b]	5 ppm (9 mg/m^3)	227 meters (746 feet)
	IDLH	75 ppm (135 mg/m^3)	103 meters (336 feet)
Hydrazine	OSHA PEL	1 ppm (1.31 mg/m^3)	117 meters (383 feet)

Exhibit 4-9. Potential Exceedances Due to Accidental Oxidizer or Fuel Leak to Air During Fueling Activities

Propellant	Health Standard	Standard Limit	Exceedance Distance
	ACGIH STEL	0.1 ppm (0.131 mg/m^3)	36 meters (118 feet)
	IDLH	50 ppm (65.5 mg/m^3)	Not Exceeded

Source: Modified from U.S. Army Space and Missile Defense Command, 2002c
Notes:
[a] The OSHA PEL is the level of exposure that must not be exceeded when the exposure is averaged over an 8-hour workday and a 40-hour workweek in the workplace.
[b] The NIOSH STEL (or OSHA STEL or ACGIH STEL) is the level of exposure that must not be exceeded at any time during a workday when the exposure is averaged over 15 minutes.
[c] The IDLH is the level of exposure (not time-weighted) above which it is anticipated a person would suffer life-threatening or irreversible health effects or other injuries that would impair them from escaping the hazardous environment.
[d] The ACGIH TLV is an average value of exposure over the course of an 8-hour work shift.
[e] Exceedance Distance-Average of U.S. Air Force Toxic Corridor model results for 15-minute and 30-minute averaging time and multiple stability classes.

Boosters could arrive at the test range with the kill vehicle attached, or the booster may be shipped separately from the kill vehicle. In either case, the fuel and oxidizer tanks would be installed in the kill vehicle at the test site. If the booster is shipped separately from the kill vehicle, the kill vehicle would be mated to the booster in a missile assembly building at the launch facility. These structures are commonly used for these types of activities and no impacts to health and safety would be expected from the mating and assembly process. (U.S. Army Space and Missile Defense Command, 2003)

Launch/Flight Activities

Launch activities would produce the same impacts on health and safety in all of the biomes considered in this PEIS. Potential impacts to health and safety include exposure to explosives, contact with launch debris, and exposure to noise produced during launch. Because launches would take place on facilities with restricted access, members of the public would not be exposed to these hazards.

Appropriate health and safety standard operating procedures would be developed to protect personnel. Every reasonable precaution would be taken during the planning and execution of a launch to prevent injuries.

A written procedure for all explosive activities is required and must be approved by the appropriate range authorities. Established procedures to prohibit access to restricted areas would be followed. The restricted areas are based upon the probability of potential hazards involved with malfunction during launches and would include

- The impact limit line, which sets the boundary protection line for all non-mission essential personnel;
- The launch caution corridor, an area limited to essential personnel;
- The LHA, an area around the launch point limited to essential personnel in hardened facilities; and
- The stage or booster impact area.

Impact zones for each launch would be delineated based on detailed launch planning and trajectory modeling, which would include analysis and identification of a flight corridor. Flights would be conducted when trajectory modeling verifies that launch-related debris would be contained within predetermined areas, all of which would be located away from inhabited land and populated areas.

Launch-related personnel that would be exposed to noise in excess of applicable standards including OSHA regulation 1910.95 would be required to wear appropriate hearing protection, which would reduce the noise levels to prescribed health and safety levels.

Postlaunch Activities

There is the potential for impact of debris from boosters and kill vehicles at any point along the flight corridor due to missile malfunction and/or termination of a missile flight by the FTS. The resulting debris would follow a ballistic trajectory and would impact in designated impact areas either on land or in the ocean. Because an exact point of termination cannot be determined, the potential effects footprint is determined by considering the limits of debris fallout based on destruction of a test missile at the boundaries of the acceptable flight corridor, along with additional flight time based on the time required to initiate the FTS. The possibility of debris hitting the ground or water outside the designated impact area is remote; and therefore, safety impacts of flight termination would not be significant. Debris modeling and analysis would be conducted for specific proposed activities as appropriate.

Launch Debris on Land. Procedures would be developed to establish appropriate debris recovery procedures, as necessary, and would include personal protective equipment and determination of appropriate recovery zone hazard boundaries. Therefore, no health and safety impacts would be expected from postlaunch activities.

Exhibit 4-10 indicates the results of an analysis using the U.S. Air Force Toxic Corridor Model to determine distances at which various health standards could be exceeded based on the release of residual propellant at the debris impact area. The analysis was conducted for non-pre-fueled liquid propellant boosters assuming 473 liters (125 gallons) of the remaining oxidizer and 265 liters (70 gallons) of the remaining fuel were released

to the atmosphere. People located at distances in excess of the exceedance distance would not experience impacts to health and safety from postlaunch activities.

Exhibit 4-10. Potential Exceedances Due to Accidental Oxidizer or Fuel Leak at the Booster Impact Site

Propellant	Health Standard	Standard Limit	Exceedance Distance
Inhibited Red Fuming Nitric Acid (IRFNA)	OSHA PEL	2 ppm (5 mg/m^3)	213 meters (699 feet)
	NIOSH STEL	4 ppm (10 mg/m^3)	140 meters (458 feet)
	IDLH	25 ppm (65.5 mg/m^3)	50 meters (164 feet)
Hydrogen Peroxide	OSHA PEL	1 ppm (1.4 mg/m^3)	195 meters (639 feet)
	NIOSH STEL	1 ppm (1.4 mg/m^3)	195 meters (639 feet)
	IDLH	75 ppm (105 mg/m^3)	11 meters (36 feet)
Nitrogen Tetroxide	ACGIH TLV	3 ppm (5.4 mg/m^3)	1,074 meters (3,525 feet)
	ACGIH STEL	5 ppm (9 mg/m^3)	740 meters (2,429 feet)
	IDLH	75 ppm (135 mg/m^3)	274 meters (899 feet)
Hydrazine	OSHA PEL	1 ppm (1.31 mg/m^3)	462 meters (1,515 feet)
	ACGIH STEL	0.1 ppm (0.131 mg/m^3)	123 meters (404 feet)
	IDLH	50 ppm (65.5 mg/m^3)	13 meters (44 feet)

Source: Modified from U.S. Army Space and Missile Defense Command, 2002c

Launch Debris in Water. Booster trajectories would be established to preclude potential water impacts in heavily trafficked ocean areas. Notices to Mariners (NOTMARs) would be issued as appropriate to advise mariners of the projected impact area. In the event of a flight termination, the possibility of debris impacting a sea vessel would be remote, and therefore safety impacts of flight termination would not be significant.

During flight termination or catastrophic missile failure of solid propellant boosters, pieces of unburned propellant could be dispersed over an ocean area of up to several kilometers. Once in the water, ammonium perchlorate could slowly leach out. In 1985, perchlorate was detected in wells of California Superfund sites; however, perchlorate contamination was not detected nationwide until 1997. Currently there are no Federal drinking water standards for perchlorate. The EPA has the responsibility to establish national drinking water standards and has issued draft risk assessments of perchlorate. These assessments have been criticized because it has been suggested that the findings are based on flawed scientific studies and that not all available data were considered and incorporated. Because of these controversies, the EPA, DoD, DOE, and NASA asked the National Research Council (NRC) to independently assess the adverse health effects of perchlorate ingestion from clinical, toxicological, and public health perspectives. The NRC was also tasked to review the scientific literature and findings from the EPA's 2002

draft risk assessment, *Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization*.

Although there are no Federal drinking water standards for perchlorate several states have proposed interim guidance levels or goals for perchlorate levels in drinking water. In March 2004, the State of California Office of Environmental Health Hazard Assessment established a public health goal for perchlorate in drinking water of 6 parts per billion. (California Office of Environmental Health Hazard Assessment, 2005) The NRC study considered the health impacts from perchlorate exposure. The results of this study and an overview of additional relevant studies on the impacts of perchlorate on human health and the environment are discussed in Appendix M of this PEIS.

Perchlorate can impact thyroid function because it inhibits the transport of iodide into the thyroid. The NRC study examined short-term studies that found that to negatively impact the thyroid, iodide uptake by the body would need to be reduced by at least 75 percent for months or longer. The NRC reported results of longer term studies that found that to cause hypothyroidism in adults would require them to be given more than 0.40 milligrams per kilogram (mg/kg) of perchlorate (assuming a body weight of 70 kilograms). However, in pregnant women, infants, children, and people with low iodide intake or pre-existing thyroid dysfunction, the dose required to cause hypothyroidism may be lower.

Epidemiologic studies considered by the NRC have examined the relationship between perchlorate exposure and thyroid function and thyroid disease in newborns, children, and adults. The NRC concluded that no studies have investigated the effect of perchlorate exposure in vulnerable groups, such as low birth weight or preterm infants. In addition, these studies have not considered the impacts to the offspring of mothers who were exposed to perchlorate and had a low iodide intake. Finally, adequate studies have not been completed of maternal perchlorate exposure and neurodevelopmental outcomes in infants.

The NRC study considered the applicability of animal toxicology studies to human health and found that although studies in rats provide useful qualitative information on potential adverse effects of perchlorate exposure, they have limited applicability for quantitatively assessing human health risks associated with perchlorate exposure.

The NRC study also reviewed EPA's findings presented in the 2002 perchlorate risk assessment. A primary purpose of EPA's perchlorate risk assessment was to calculate a reference dose (RfD). The NRC study did not agree with the basis of the EPA's study, which relied on animal data. The NRC reviewed both human and animal data and found that the human data formed a better basis for risk assessments. The EPA study's draft RfD for perchlorate was 0.00003 mg/kg per day and the NRC study recommended an RfD of 0.0007 mg/kg per day. The NRC stated that this value is supported by other

clinical studies, epidemiologic studies, and studies of long-term perchlorate administration. The NRC report concluded that the proposed RfD of 0.0007 milligrams per kilogram per day should protect even the most sensitive populations. The EPA has established an official RfD of 0.0007 mg/kg/day of perchlorate consistent with this recommended RfD, which translates into a Drinking Water Equivalent Level of 24.5 ppb.

Noise

Prelaunch Activities

Prelaunch activities including evacuation and road closure activities and storing boosters, propellants, and kill vehicles would have no impact on noise.

Launch/Flight Activities

Launch activities would produce the same noise levels in all of the biomes considered in this PEIS. The potential for impact would depend on the specific launch location. Three possible issues must be addressed to determine potential noise impacts, including personnel safety, public safety, and public annoyance. The impact of noise from launches on biological resources is addressed in Biological Resources. Launches would not add new types or levels of noise to the current noise environment at existing launch sites. Noise levels produced by BMDS launches would be similar to past and current noise levels at launch sites. Launches would be relatively short noise events during which all personnel would be located in various control or blockhouses and therefore would be protected from noise by the sound attenuation provided by the building's construction. Zones in the operations area with high noise levels would be designated off-limits to non-essential personnel. Entry into these zones would be prohibited except to personnel wearing hearing protection that would reduce noise.

Sonic booms may be generated during launch or booster reentry. Each booster would propagate a unique sonic boom contour depending upon its mass, shape, velocity, and launch or reentry angle, among other variables. Areas affected by a sonic boom could extend up to several miles on each side of the focal point of the sonic boom. Sonic booms may produce overpressures as high as 8 to 16 pounds per square foot, but this would be of very short duration, lasting up to several milliseconds. (U.S. Army Space and Strategic Defense Command, 1994a) These levels of sonic booms can have minor effects on physical structures (glass failure, plaster may crack, etc.) but are not strong enough to cause injury to people.

Air Operating Environment. Noise generated by the booster launched from an air platform would reach the Earth's surface. Prior analyses of air-launched boosters showed that an Air Drop vehicle launched from an altitude of approximately 5,000 feet above MSL would generate approximately 115 dBA at ground level directly below the launch

point. (BMDO, 1998) The noise levels that reach the ground will vary depending on the altitude and attitude at which the booster is launched. This noise would decrease rapidly as the launch altitude increases; thus, launch noise would be brief.

Sea Operating Environment. Launches from sea platforms in the BOA would have fewer noise impacts because of the distance of the sea operating environment from population centers. Essential personnel would be located in an area of the sea launch environment that is protected from the noise generated during launch. Non-essential personnel would be moved to a safe distance and would be protected from the noise generated during launches. Personnel that may be exposed to loud noises would be required to wear hearing protection, such as earplugs or earmuffs, which would reduce noise levels to prescribed health and safety levels.

Postlaunch Activities

Impacts of noise from launch debris recovery activities on land are discussed below.

Launch Debris on Land. Vehicles used for booster and kill vehicle debris recovery operations (trucks and helicopters) on land would produce noise. Each recovery operation would be expected to last less than one day; thus, noise associated with debris recovery would not be a constant occurrence. Helicopter flight helmets would provide the required noise attenuation for the crew. Noise impacts from debris recovery operations would be minor.

Transportation

Prelaunch Activities

Prelaunch activities including booster fueling, road closure, and evacuations would not impact transportation. Road closures would be implemented in the areas around the launch site and along the expected trajectory. These temporary road closures would be of short duration and would be considered routine occurrences for launch sites. Prominent notices would be posted to notify the general public and local businesses of expected closures. Therefore, impacts on traffic are not expected to be significant. Existing agreements regarding road closures would be followed. These impacts would be the same in all of the biomes considered in this PEIS. Any disruption due to military convoys or roadblocks would be of short duration and would not be expected to have a significant impact on transportation.

Propellants for non-pre-fueled liquid propellant boosters would be transported from the storage facility to the fueling location in accordance with appropriate regulations and would not be expected to pose significant impacts to transportation.

Launch/Flight Activities

Issuance of NOTMARs is standard practice when a launch has the potential to impact marine areas and would allow marine vessels to clear the affected area; thus, launch activities would have no impact on marine transportation

In some biomes there are few roads and much of the transportation in the region occurs by airplane. Therefore, while launches may have little to no impact on ground transportation due to road closures, air transportation may be temporarily affected. NOTAMs would be issued prior to launch events that would notify pilots of proposed airspace closures and would permit pilots to find new routes or to delay their trip until after the airspace is reopened. Impacts to air transportation are discussed above in Airspace.

Postlaunch Activities

Impacts to transportation from debris recovery are addressed separately for land and water below.

Launch Debris on Land. Trucks and mobile ground equipment used for debris recovery operations for boosters and kill vehicles would travel both on- and off-road. Debris recovery requires a relatively small number of vehicles and therefore, is not expected to impact traffic or transportation infrastructure.

Launch Debris in Water. Debris from boosters and kill vehicles may fall into waters normally occupied by commercial shipping. The majority of international trade uses routes of least distance. The actual debris impact area for boosters and kill vehicles would be small and would depend upon the individual flight path. Prior warning of proposed launch activities through issuances of NOTMARs would enable commercial shipping to follow alternative routes away from the proposed debris impact area.

Water Resources

Prelaunch Activities

Adherence to existing policies and procedures would minimize the impacts from spills related to pre-fueled and solid propellant boosters and kill vehicles. Fueling of non-pre-fueled liquid propellant boosters would be conducted in accordance with approved procedures and all applicable regulations. All fueling would be conducted using appropriate impermeable barriers that would prevent spills from reaching bodies of water.

__Launch/Flight Activities__

Small amounts of hydrochloric and hydrofluoric acids would be generated from the launch of pre-fueled liquid propellant boosters. These acids could reach surface water if rainfall occurred within two hours of a launch. This is most likely to occur in the Arctic Tundra, Sub-Arctic Taiga, Deciduous Forest, and Mountain Biomes where rain is a frequent occurrence. In addition, hydrochloric acid could be produced in the Sub-Arctic Taiga, Chaparral, Grasslands, and Savanna Biomes when cool and humid conditions exist during launch activities. Given the dry conditions in the Desert Biome it is unlikely that chlorine would be converted to hydrochloric acid. The Tropical Biome is generally humid but the temperatures are not cool enough to convert the HCl produced as a result of launches to hydrochloric acid. In the BOA, the acid produced would be neutralized by calcium carbonate in ocean water. However, exhaust emissions from pre-fueled liquid propellant missiles would not significantly impact water quality.

Launch of solid propellant boosters could result in deposition of small amounts of Al_2O_3 from booster exhaust. This exhaust product could be deposited in surface waters. EPA has determined that Al_2O_3 as found in solid propellant exhaust is nontoxic. (NASA, 1990, as referenced in U.S. Army Space and Strategic Defense Command, 1994a) Al_2O_3 would be hazardous only in acidic biomes (pH less than 5) where it would dissociate into free aluminum cation. (FAA, 1996, as referenced in U.S. Army Space and Missile Defense Command, 2003)

In biomes where rain is a frequent occurrence, launches with solid boosters have an increased likelihood of contributing to acid rain, thereby increasing the amount of HCl deposited in regional surface waters. In areas with low velocity of surface and ground water movement and relatively shallow ground water table it is possible that deposition of acidic water may impact water resources. The potential for and extent of impact would need to be examined in site-specific environmental analysis.

In the absence of substantial surface and ground water bodies, launch exhaust emissions are unlikely to impact water resources. Additionally, in many desert areas, the ground water table is lower than six meters (20 feet) below ground level, which would inhibit contamination from surface pollutants. For example, the evaporation and deposition of dissolved solids in the water for thousands of years has formed a hardpan over much of the Tularosa Basin, which houses an aquifer that underlies WSMR, New Mexico, and Fort Bliss, Texas. The hardpan consists of impermeable silt and clay and aids in preventing pollution of the aquifer from the land surface. It is unlikely that the aquifer could be contaminated from surface seepage from the lower elevations of the basin. This eliminates any direct channeling to the water table. (Carmichael, 1986, as referenced in U.S. Army WSMR, 1991)

Postlaunch Activities

If residual liquid propellants were deposited in surface water (either in the ocean or in lakes or streams), nitric acid would cause a short-term pH change in the water body. The acid would mix with the water and eventually be neutralized and diluted. Hydrogen peroxide in surface water would decompose into water and oxygen within eight hours to 20 days. Kerosene or JP-8 fuel would not mix with the water, but would form a slick on the surface that would stick to surfaces it contacts. Hydrazine fuels would degrade primarily into N_2 gas and water over a period of hours to weeks, with degradation proceeding more rapidly in alkaline waters.

Impacts to water quality from a direct release on land are described in the hazardous waste section above.

<u>*Launch Debris in Water*</u>. In some instances, an early flight termination could result in propellant and debris deposition in water bodies. Some perennial surface waters could be impacted following a flight termination. However, the probability of any individual water body, spring, or creek being directly impacted is extremely low and would be a function of the amount of surface water in the impact area. An early flight termination also could possibly impact in an area of shallower ground water or an aquifer recharge zone. In any of these unlikely events, the appropriate officials would be notified.

In the event of a failure, effluents may enter water bodies if the debris impacts in surface water areas. These effluents could enter underground sources of drinking water in areas where there is a shallow ground water table. However, the release rates of materials that impact surface water would be such that no significant changes in surface water quality would be detectable.

The booster and kill vehicle would consist primarily of inert metal objects that would have little potential to contaminate water bodies. In general, a typical water contamination response would include

- Rendering the booster or debris safe,
- Stopping the flow of oxidizer or fuel,
- Neutralizing the oxidizer in the stream (or body of water) sufficiently far downstream so as to avoid a continuing hazard to water quality,
- Installing surface skimmers and absorptive materials downstream from the lead edge of contamination to collect the fuel,
- Monitoring the pH along the stream to ascertain that a background pH level has been established, and
- Removing all petroleum products from stream surfaces and returning the damaged area to an environmentally sound level.

Orbital Debris

Prelaunch Activities

No orbital debris would be produced from prelaunch activities.

Launch/Flight Activities

Orbital debris could be produced from launch/flight activities in the event of a booster failure while in the exoatmosphere. However, any debris would not be expected to remain in orbit for more than a short time, followed by deorbiting and eventual burn-up during reentry of the Earth's atmosphere.

Postlaunch Activities

A failure of a booster in the exoatmosphere may generate orbital debris. The type of orbital debris produced from a booster failure would be similar to that produced from a high altitude successful intercept. However, the amount of debris from a booster failure would be less than that produced from an intercept. The impacts of orbital debris from intercepts are discussed in Section 4.1.2.10 and were found to not pose significant impacts. Therefore orbital debris from a booster failure would similarly not pose significant impacts.

4.1.1.3 Sensors - Radars

As described in Exhibit 4-3, the analysis for radars is based upon impacts from the activation of the radar.

Air Quality

Activation emissions from radars would be limited to exhaust produced by generators. Impacts related to generator emissions are discussed in Support Assets. These impacts would be the same in all of the biomes considered in this PEIS.

Airspace

During activation of land-based radars, NOTAMs would be issued and pilots would be restricted from EMR hazard areas. NOTAMs would be sent in accordance with the conditions of the directive specified in Army Regulation 95-10, Operations to notify aircraft of EMR hazard areas during the activation of radars. Airspace restrictions would be short-term events and would not pose a significant impact on available airspace. Sufficient notice of restricted areas would be provided to allow pilots to select alternate flight paths to avoid restricted areas.

The activation of radars in the Sub-Arctic Taiga Biome may impact small civilian aircraft, which frequently transit the biome at low altitudes. Because many remote civilian airports within this biome do not have operating control towers, some aircraft pilots may be required to upgrade their communication equipment (at their own expense) to ensure that they are aware of activation activities and areas that must be avoided. Civilian aircraft would be required to contact local range control towers when transiting restricted airspace. The controllers would then be able to advise civilian pilots as to their proximity to hazard areas during activation of radars. (U.S. Army Space and Missile Defense Command, 2000) Other biomes including Arctic Tundra and the BOA are unlikely to experience impacts because small civilian aircraft would not readily occur in these regions. The Deciduous Forest, Chaparral, Grasslands, Desert, Tropical, Savanna, and Mountain Biomes are unlikely to experience impacts because these biomes are more likely to have operational control towers that could communicate with civilian aircraft.

For activation activities occurring in international airspace, procedures of the ICAO would be followed. ICAO Document 4444 is the equivalent air traffic control manual to the FAA Handbook 7110.65, Air Traffic Control. Personnel would ensure coordination with the ICAO through the FAA, to issue NOTAMs, locate ships with radar capable of monitoring the airspace, contact all commercial airlines and civil and private airports, and monitor appropriate radio frequencies to minimize potential safety impacts.

During activation of radars in the BOA, at least one Control Area Extension corridor in the BOA would remain available for use by general aviation and commercial air carriers.

Potential interference to aircraft electronic and emitter units (e.g., flight navigation systems and tracking radars) would be examined before activation of radars. A high-energy radiation area would be configured to mitigate potential impacts to aircraft and other potentially affected systems and a notice would be published on the appropriate aeronautical charts, notifying aircraft of the radio frequency radiation area. Boundaries of these radio frequency radiation areas would be configured to minimize impacts to aircraft operations and other potentially affected systems. In addition information would be published in the Airport Facility section of the FAA Airport Guide. Flight service personnel would brief pilots flying in the vicinity about the radio frequency radiation area. Radar operations would be coordinated with FAA and range officials and if possible would be programmed to limit radio frequency emissions in the direction of airways that pass within the potential interference distance.

EMR from radar activation may interact with and adversely affect aircraft operations by disabling or inadvertently initiating vital electronic equipment, including electroexplosive devices on-board aircraft. Electroexplosive devices on aircraft in flight could be illuminated by a radar main beam. Software controls and coordination with military and commercial aircraft controllers would eliminate this potential hazard. (U.S. Army Space and Missile Defense Command, 2003)

The FAA and DoD have standards, such as MIL-STD-464, for EMR interference with aircraft, which would not be exceeded. To operate in an affected area, military aircraft would have to be hardened or protected from EMR levels up to 3,500 volts per meter (peak power) and 1,270 volts per meter (average power). Commercial aircraft must be hardened or protected from EMR levels up to 3,000 volts per meter (peak power) and 300 volts per meter (average power) as mandated by the FAA by Notice 8110.71, Guidelines for the Certification of Aircraft Flying through High Intensity Radiated Field Environments. Radars would not exceed the 3,000 volts per meter power threshold.

Reducing the time on-board electronic equipment is exposed to EMR would lower the average power threshold experienced. (U.S. Army Space and Missile Defense Command, 2003) Commercial aircraft equipment would be affected only if the main beam illuminated the aircraft long enough to affect on-board electronics. Because radars are typically in constant motion, it is highly unlikely that a radar would illuminate an aircraft long enough to interfere with on-board electronics.

Activation impacts from air- and sea-based radars would be similar to those described for land-based radars. Radars located on sea-based operating environments would most likely be located far enough off the coast to not interfere with existing airfield or airport arrival and departure traffic flows. Activation of space-based radars would not be expected to impact airspace.

Biological Resources

Radar activation activities would produce the same impacts on biological resources in all of the biomes considered in this PEIS. The potential for main-beam exposure thermal effects to animals, especially birds, exists from the activation of land- and air-based radars. The *Final Ground-Based Radar Family of Radars Environmental Assessment* (1993) and *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement* (2003) analyzed potential impacts on wildlife from EMR. Additional analysis is provided in this PEIS in Appendix N. Potential effects include exposure of birds to the main radar beam, which could result in thermal heating or interference with the navigation of migratory birds, EMR impacts from the COBRA DANE radar operating on Eareckson Air Station on Shemya Island, Alaska, bird collisions with radar and radar equipment, and effects in the near shore environment.

Appendix N evaluates under what conditions a BMDS radar beam could be sufficiently powerful to cause thermal heating or to interfere with the navigational ability of migratory birds. The proposed BMDS radars would operate within five different wavebands: UHF, L, S, C, and X bands. For each of the five bands, the most powerful type of radar operating in that band was evaluated. The representative radar from each band is PAVE PAWS for UHF, COBRA DANE for L-band, Aegis for S-band, MPS-36 for C-band and SBX for X-band.

The conservative analysis presented in Appendix N indicated that there is no concern for birds flying through radar beams emanating from the X-band, C-band and UHF radars. This applies to bird flights perpendicular to or in the direction of stationary beams, as well as for beams in surveillance mode. However, for the L-band COBRA DANE radar, there may be some risk to birds flying at flight altitudes of less than 1,700 meters above the radar, when the beam is elevated between four and fifty degrees above horizontal. This is a worst-case scenario for birds migrating from Alaska along the Pacific Oceanic migration route that might fly parallel to the COBRA DANE radar beam for a portion of their flight. Birds migrating from Alaska to Asia are likely to be flying more perpendicular or at an angle to the radar beam than parallel to the beam. For higher beam elevations and for lower flying birds, migrating birds flying parallel to the beam may not receive exposures above the no-harm reference value.

In Appendix N, MDA has considered mitigation measures to reduce the possible risks to migrating birds. The mitigation measures discussed in Appendix N include

- Evaluating the possibility that the COBRA DANE radar might be tested with stationary beams during spring and fall migrations.
- Evaluating whether the locations where the COBRA DANE radar would be used are in a significant migratory route or near to a migratory stopover, such that large migratory flocks might on occasion pass through the radar beam.
- Considering use of a local Next Generation Weather Radar (NEXRAD) to help evaluate when large flocks might be in the vicinity of the radar if a risk to migratory flocks is deemed to exist, so that the timing of a test does not coincide with particularly large flocks of birds flying close to the radar.

Bird collisions with radars and radar equipment also are a concern. MDA could mitigate this risk by using highly visible paints and a change in brightness of warning lights on the antenna towers and guy wires to minimize the potential for bird collisions with radar equipment. Overall, no significant impacts to birds would be expected from the operation of radars.

Potential impacts on wildlife from the activation of sea-based radars in the near shore environment would include seabirds and shorebirds, including migratory species, striking the antennas, telescopes, and shelters or becoming disoriented due to high intensity lighting at night. To minimize the occurrence of bird strikes, antennas would be raised only as necessary and colorful streamers or other visual indicators could be used to increase visibility to birds, if there is no interference with the operation of the radar. To prevent birds from becoming disoriented, high intensity lighting would be used only when necessary and low intensity lighting would be used whenever possible. Lighting would be adequate for safe working conditions but minimized to the extent practical.

Radar main beams on sea-based operating environments would not be directed toward the ocean surface, which would limit the probability of energy absorption by surface-oriented wildlife. The power density level just below the surface of the ocean where marine mammals may be located would not exceed the PEL for uncontrolled environments. (U.S. Department of the Navy, 2002a, as referenced in U.S. Army Space and Missile Defense Command, 2003) No adverse impact would occur to whales, other marine mammals, or sea turtles found at least 1.3 centimeters (0.5 inch) below the surface. It is also highly unlikely that an individual would be on or substantially above the surface of the water for a significant amount of time within the main beam area during radar activation. Therefore, no impacts are anticipated to whales, other marine mammals, or sea turtles that might be present in the vicinity of the radar.

Previous analysis (U.S. Army Space and Missile Defense Command, 2003) has shown the potential EMR interference distance for fully-populated XBR to be only 19 kilometers (12 miles). Because space-based platforms would be placed in LEO or GEO at altitudes ranging from approximately 160 to 1,600 kilometers (100 to 1,000 miles) for LEO and approximately 35,000 kilometers (21,700 miles) or greater for GEO, it is expected that EMR would not reach Earth; thus, the activation of space-based radars would not be expected to impact biological resources.

Geology and Soils

Radar activation activities would produce the same impacts on geology and soils in all of the biomes considered in this PEIS. Impacts to geology and soils from activation of radars would be limited to accidental spills of diesel fuel from generators used to support the activation of radars. Potential impacts from releases of diesel fuel are discussed in Support Assets.

Hazardous Materials and Hazardous Waste

Radar activation activities would produce the same hazardous materials and hazardous waste impacts in all of the biomes considered in this PEIS. The types of hazardous materials used and waste generated would be similar to those currently used and generated at military installations. Antifreeze and fire suppressants would be used for radar electronic systems. Cooling equipment units would use coolant fluids, such as a mixture of ethylene glycol and water. In addition, radar components and antenna units may require periodic application of petroleum-based lubricating oils. Used petroleum, oil, and lubricants would be generated in smalls amounts are not normally considered hazardous waste (designation varies by state). (U.S. Army Space and Strategic Defense Command, 1993c) All hazardous materials used and hazardous waste generated during the activation of land- and air-based radars would be handled in accordance with applicable regulations. Accidental releases of hazardous materials would be contained in accordance with site-specific spill plans.

Temporary storage tanks and other facilities for the storage of hazardous materials would be located in protected and controlled areas designed to comply with SPCC plans. Hazardous wastes generated during radar activation activities may consist of materials such as waste oils, hydraulic fluids, cleaning fluids, cutting fluids, and waste antifreeze. The minimal quantities of hazardous waste that could potentially be generated would be disposed of in accordance with appropriate waste disposal regulations.

Impacts from hazardous materials and hazardous waste management for sea-based radars would be similar to those described for land- and air-based radars. The U.S. Navy requires that, to the maximum extent practical, ships retain hazardous waste onboard for shore disposal. If hazardous materials are discharged overboard, this must occur more than 370 kilometers (200 nautical miles) from land. Discharging hazardous materials overboard is not standard practice and would only be done in emergency situations. Twenty-five liquid discharges, such as clean ballast, deck runoff, and dirty ballast, from normal operation of military vessels are required to be controlled by installation of control technologies or use of management practices (marine pollution control devices) under the Uniform National Discharge Standard provisions of the Clean Water Act. In compliance with Uniform National Discharge Standards, the sea-based operating environment would incorporate marine pollution control devices, such as keeping decks clear of debris, cleaning spills and residues, and engaging in spill and pollution prevention practices, in design or routine operation.

Health and Safety

Radar activation activities would produce the same impacts on health and safety in all of the biomes considered in this PEIS. Safety precautions for handling, storing and transporting hazardous materials and hazardous waste releases would be followed at sites involved in BMDS activities. Each site would follow spill control and emergency response plans that would provide response actions for cleanup. Sites would maximize on-site and off-site recycling to reduce the need for waste disposal sites and handle or dispose of hazardous materials or wastes in compliance with all applicable laws, regulations, and guidance. (U.S. Army Space and Strategic Defense Command, 1993b)

Prior to activation of radars, an EMR survey would be conducted that considers hazards of EMR to personnel, to fuels, and to ordnance. The analysis would provide recommendations for sector blanking and safety systems to minimize exposures. Appropriate safety exclusion zones would be established before operation, and warning lights to inform personnel when the system is operating and emitting EMR would be installed.

Personnel exclusion areas would be established to protect personnel from potential EMR hazards during radar activation. Personnel not involved in test event activities would not be permitted to enter established hazard zones during the activation of radars. EMR

hazard zones would be established within the main beam's tracking space near emitter equipment. A visual survey of the area would be conducted to verify that all personnel are outside of the hazard zone prior to activation. Safety exclusion zones would also be established around generator wiring and cabling to protect personnel from high voltage exposure.

Potential health and safety hazards associated with the operation of radars were analyzed in previous documents. Two examples of these are *Ground-Based Radar Family of Radars Environmental Assessment* (1993) and *Environmental Assessment for Theater Missile Defense Ground-Based Radar Testing Program at Fort Devens, Massachusetts* (1994). These analyses considered operational requirements and restrictions and range-required safety procedures. It was determined that implementing safety procedures, including establishing controlled areas and limitations in the areas subject to illumination by radars, would preclude any potential safety hazard to either the public or project-related personnel from exposure to EMR.

The analysis method used to evaluate potential impacts of radio frequency radiation is the IEEE Maximum Permissible Exposure (MPE), which defines the maximum time-averaged radio frequency power density allowed for uncontrolled human exposure. The MPE method is independent of body size or tissue density being exposed. EMR hazard zones provide a safety factor 10 times greater than the MPE. MPEs are capped at 5 megawatts per square centimeter for frequencies greater than 1,500 MHz. (IEEE C95.1-1999, Standard for Safety Levels with Respect to Human Exposure to Radiofrequency EM Fields, 3 kilohertz to 300 GHz) General public exposure is typically limited to one fifth of the occupational limits.

At X-band frequencies, the IEEE standard for human exposure is 5.33 megawatts per square centimeter. For radars to have an effect on human health, the beam operating at full power would have to come in contact with a person and remain on them for 7.5 minutes (at 8,000 MHz) or 11.25 minutes (at 12,000 MHz). (U.S. Army Space and Missile Defense Command, 2003) The beam would normally be in motion, which would reduce the likelihood that a person would remain within the most intense area of the beam for any considerable length of time.

In addition to the impacts described above, activation of radars on sea-based operating environments would be coordinated with the FAA, U.S. Coast Guard, and other groups or agencies as appropriate. The implementation of software controls would prevent a radiation hazard zone from occurring on the deck of the sea-based operating environment.

Noise

Radar activation activities would produce the same noise impacts in all of the biomes considered in this PEIS. Noise impacts associated with activation of radars would be limited to noise produced by generators. Impacts related to generator noise are discussed in Support Assets.

Transportation

The activation of radars has the potential to impact air transportation. These impacts are discussed in Airspace. These impacts would be the same in all of the biomes considered in this PEIS.

NOTMARs would be issued in advanced of test events; therefore, commercial marine vessels would be able to choose transportation routes outside of proposed radar activation areas.

Water Resources

Additional personnel would be needed for the activation of radars; these personnel would increase the demand for potable water. An increase in demand could exceed the capacity of the existing infrastructure at some locations. (U.S. Army Space and Missile Defense Command, 2003) This is of particular concern in portions of the Sub-Arctic Taiga, Grasslands, Desert, Tropical, and Mountain Biomes. It is anticipated that additional packaged potable water systems would be installed to meet the demands in areas where access to potable water is limited. Site-specific studies should consider the limited potable water supplies in these areas when analyzing the impacts to water resources from the proposed activation of radars. Other biomes including Arctic Tundra, Sub-Arctic Taiga, Deciduous Forest, Chaparral, and Savanna Biomes are unlikely to experience impacts to water resources. Due to ample ground water supply, it is unlikely that a significant increase in demand would exceed the capacity of existing infrastructure in these biomes.

Impacts to water resources from activation of radars would include potential release of hazardous materials. Materials released from sea-based operating environments would be rapidly diluted and would not be found at concentrations identified as producing any adverse impacts due to the high buffering capacity of sea water in the open ocean. The ocean depth in the vicinity of sea-based radar would most likely be thousands of meters deep, and consequently, any impact from fuel or hazardous material spills would be minimal. From land- and air-based operating environments, impacts from hazardous materials releases would depend on the characteristics of the water bodies in the respective biome. No impacts to water resources would occur as a result of space-based sensors that would be in GEO.

Orbital Debris

No impacts from orbital debris would occur as a result of the activation of land-, air-, and sea-based radars.

Orbiting objects lose energy through friction with the upper atmosphere and various other orbit perturbing forces. Over time, an object may drop into progressively lower orbits and may eventually fall to Earth. As the object's orbital trajectory draws closer to Earth, it speeds up and outpaces objects in higher orbits. Once the object enters the measurable atmosphere, atmospheric drag will slow it down rapidly and cause it either to burn up or deorbit and fall to Earth.

Space-based radars could reenter the Earth's atmosphere due to failure, but would not likely result in significant impacts. Most objects break up and often vaporize under the intense aerodynamic forces and heating that occur during reentry. Most of the objects which reenter would fragment and burn in the upper atmosphere and would make only negligible changes in its chemical composition. An estimated 500 objects and thousands of debris fragments reenter the Earth's atmosphere each year; however, few survive reentry. Out of approximately 3,100 objects from 44 launches between 1956 and 1972, only 100 have survived reentry and been recovered. Even if an object does survive reentry, only one third of the Earth is land area, and only a small portion of this land area is densely populated. The chance of hitting a populated land area upon reentry would be small. (SDIO, 1992)

4.1.1.4 Sensors - Infrared and Optical Sensors

As described in Exhibit 4-3, the analysis for infrared and optical sensors is based upon impacts from the activation of the sensors.

Air Quality

Activation emissions from infrared and optical sensors would be similar to those discussed for radars. These impacts would be the same in all of the biomes considered in this PEIS.

Airspace

No impacts to airspace would be expected due to the activation infrared and optical sensors.

Biological Resources

No impacts to biological resources would be expected due to the activation infrared and optical sensors.

Geology and Soils

Impacts to geology and soils from activation of infrared and optical sensors would be similar to those discussed for radars. Infrared and optical sensor activation activities would produce the same impacts on geology and soils in all of the biomes considered in this PEIS.

Hazardous Materials and Hazardous Waste

Impacts to hazardous materials and hazardous waste from activation of infrared and optical sensors would be similar to those described for radars.

Health and Safety

Safety exclusion zones would be established around generator wiring and cabling to protect personnel from high voltage exposure. These impacts would be the same in all of the biomes considered in this PEIS.

Noise

Noise impacts associated with activation of infrared and optical sensors would be similar to those described for radars. These impacts would be the same in all of the biomes considered in this PEIS.

Transportation

There would be no impacts to transportation from the activation of infrared and optical sensors.

Water Resources

Impacts to water resources from activation activities would be similar to those described for radars. These impacts would be the same in all of the biomes considered in this PEIS.

Orbital Debris

Impacts from orbital debris related to space-based sensor activities would be similar to those described for radars. See Section 4.1.1.3.

4.1.1.5 Sensors - Laser Sensors

As described in Exhibit 4-3, the analysis for laser sensors is based upon impacts from the activation of the sensor.

Air Quality

Laser sensor activation activities would produce the same air quality impacts in all of the biomes considered in this PEIS. Laser sensors include gas lasers and solid-state lasers that expend low-level infrared radiation to form a focused laser beam. (MDA, 2003a) Potential emissions produced during activation would depend on chemicals used. These emissions would typically be released to the air where the impacts would be as discussed below.

The operation of a CO_2 gas laser sensor, like the Active Ranging System (ARS) laser associated with the ABL, would include the use of helium, N_2, and CO_2. (MDA, 2003a) None of these inert gases are considered hazardous; however, they can be asphyxiants, replacing oxygen to create oxygen-deficient conditions. A leak of these gases to the atmosphere would be insignificant relative to ambient oxygen concentrations. Impacts from asphyxiants would occur only in confined areas. Gas laser sensors could use a glycol (Refrigerant 404) closed-loop cooling system. Refrigerant 404 is an ozone-depleting substance; however, the closed-loop system would prevent releases to the atmosphere. In the unlikely event that a release does occur during testing or activation, the small amount released would quickly be dispersed and would not significantly impact air quality.

Solid-state lasers like the Beacon Illuminator Laser (BILL) and the TILL associated with the ABL have crystals as the active medium. Operation of these lasers causes thermal expansion of the crystal, which alters the effective cavity dimensions, thus changing the mode structure of the laser. The lasers are cooled by non-hazardous liquids such as water and deuterium oxide, which are in closed looped systems. No pollutant emissions are associated with the testing and activation of these lasers, therefore no impacts to air quality would be expected.

Airspace

The use of laser sensors would occur in cleared airspace within designated airspace areas. Close coordination with the FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impact on airspace use. Lasing activities would be suspended immediately when ground observers using binoculars indicate an aircraft might be approaching the area; therefore, no impacts to airspace would be expected. Laser sensor activation activities from the

ground would produce the same airspace impacts in all of the biomes considered in this PEIS.

Flight-testing and activation activities for air-based laser sensors would occur at altitudes greater than 10,671 meters (35,000 feet) above MSL. Targets would be actively engaged at or above 10,671 meters (35,000 feet) above MSL, and would not engage below the 10,671 meters (35,000 feet) horizon. This would ensure activation of the laser sensors at an upward angle from the 10,671 meters (35,000 feet) horizon, and thus above commercial aircraft traffic and away from the Earth's surface. Due to the negative impacts of cloud cover on sensing lasers and the increase in air traffic below the 10,671 meters (35,000 feet) horizon, activation of lasers in a deployed situation would be conducted above the 10,671 meters (35,000 feet) horizon as well.

Activation of lasers would occur in cleared airspace within designated airspace use. Close coordination with the FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impacts on airspace use.

Biological Resources

Impacts to biological resources as a result of activation of laser sensors could occur. Ground testing of air-based lasers has the greatest potential for impacts. Wildlife in the beam path of the laser could suffer eye damage as a result of the laser activation. Due to the short duration of the laser operations during testing and the small range area used for the ground testing, impacts to wildlife would be insignificant. Laser sensor activation activities would produce the same biological resource impacts in all of the biomes considered in this PEIS.

Flight-testing and activation of air-based laser sensors would occur at an altitude of 10,671 meters (35,000 feet) above MSL or greater. Impacts from the laser operation on biological resources on the ground would be insignificant. Birds in the beam path of the laser could suffer eye damage as a result of the laser activation. However, bird densities at 10,671 meters (35,000 feet) above MSL would be extremely low, and the time of exposure to the beam path would be extremely low as well. Also, because the laser beams from solid-state laser sensors are usually not continuous, but consist of a large number of separated or pulsed power bursts, it is highly unlikely that a bird would remain within a beam for any considerable length of time. Therefore, significant impacts to birds would not be expected. (MDA, 2003a)

Impacts from the activation of land-, and sea-based lasers would be insignificant. The beam path of land-, and sea-based lasers would be directed at an upward angle from the Earth's surface, and thus would not impact biological resources on the ground. Impacts

to birds and from beam reflection would be similar to those described for air-based laser sensors.

Impacts to biological resources as a result of testing and activation of space-based laser sensors would be insignificant. In the unlikely event that the laser was directed towards the Earth's surface, distortion from atmospheric conditions would reduce the radiance level of the lasers. The ANSI refers to the eye hazard distance as the Nominal Ocular Hazard Distance. This distance is defined as "the distance along the (propagation) axis of the unobstructed beam from a laser … to the human eye beyond which the … exposure … is not expected to exceed the appropriate MPE." (MDA, 2003a)

The Earth's surface would likely be beyond the Nominal Ocular Hazard Distance of the laser sensor, and thus, the impacts would be insignificant.

Geology and Soils

No impacts to geology and soils would occur as a result of activation of land-, sea-, air-, and space-based laser sensors. The only hazardous material that would be used to cool gas laser sensors is a gas at ambient conditions and would not impact geology and soils.

Hazardous Materials and Hazardous Waste

Laser sensor activation activities would produce the same hazardous materials and hazardous waste impacts in all of the biomes considered in this PEIS. The types of hazardous materials used and waste generated would be similar to those currently used and generated at military installations. No hazardous materials would be used during activation of lasers. Gas laser sensors would use CO_2, helium and N_2 to generate the laser, but these substances are not hazardous. These gases would be held in compressed gas tanks and would be handled according to all applicable Federal, state, and local regulations. Gas laser sensors would use a glycol (Refrigerant 404) cooling system. (MDA, 2003a) Refrigerant 404 is an ozone-depleting substance. However, the cooling system would be a closed loop system, and the refrigerant would be replaced only during routine maintenance. Used refrigerant would be handled and disposed of or recycled according to all applicable Federal, state, and local regulations. Accidental releases of hazardous materials would be contained in accordance with a site-specific spill plan.

Solid-state laser sensors would use non-hazardous crystals as the laser generating medium. These sensors could use either water or deuterium in their cooling systems. (MDA, 2003a) These non-hazardous coolants would be contained in closed-loop systems and would be recycled or replaced as needed.

Health and Safety

Laser sensor activation activities would produce the same impacts on health and safety in all of the biomes considered in this PEIS. Laser sensors are created by chemical reactions that release low levels of energy in a focused energy beam that is invisible to the naked eye. Despite its relatively low energy level, the laser beams can be hazardous to the eyes of living organisms within a certain proximity (or hazard distance) specific to the parameters of the laser beam. The MPE of the laser's energy is the standard that indicates "the level of laser radiation to which a person may be exposed without hazardous effect or adverse biological change in the eye." (ANSI Z136.1, *Safe Use of Lasers*, as referenced in MDA, 2003a) The MPE is a function of laser wavelength and exposure duration, but also varies based on waveform (pulsed or chopped), and the waveform's respective parameters (e.g., for pulsed waves, pulse width and pulse repetition frequency are additional factors in the MPE calculation).

The MPE and output parameters, such as power and divergence or beam spread, can be used to evaluate the hazard at various proximities, known as the eye hazard distances. ANSI refers to the eye hazard distance as the Nominal Ocular Hazard Distance. This distance is defined as "the distance along the (propagation) axis of the unobstructed beam from a laser … to the human eye beyond which the … exposure … is not expected to exceed the appropriate MPE."

Laser light is predominantly scattered forwards and backwards, whereas relatively little is scattered sideways. Therefore, an organism would have to look straight down the beam to be at risk. Some laser beams, such as those produced by gas laser sensors, diverge once they leave the sensor, therefore a lower hazard risk would be expected as the distance between the source sensor and a receptor increases. Other laser beams, like those produced by solid-state laser sensors, may maintain or increase their focus once they leave the sensor. When the laser's focus is maintained instead of diverging, the laser may become hazardous to an organism's eyes at a certain distance (e.g., two kilometers) before the primary focus point and stay hazardous until that same distance (e.g., two kilometers) after the primary focus point. (MDA, 2003a)

The DoD follows limitations outlined in ANSI Z136.1, *Safe Use of Lasers*, for the testing and activation of laser sensors. The limitations include establishing a restricted area excluding all but authorized and properly trained personnel, displaying warning signs designating the restricted area, removing reflective surfaces, and incorporating automatic hard-stop limits and/or laser blanking devices. This last measure would ensure that laser energy does not extend beyond natural features or backstops during testing scenarios. (MDA, 2003a) Safety exclusion zones would be established around generator wiring and cabling to protect personnel from high voltage exposure.

Noise

Noise impacts associated with activation of laser sensors would be similar to those discussed for radars. These impacts would be the same in all of the biomes considered in this PEIS.

Transportation

Testing and activation of land-, sea-, air-, and space-based lasers could impact the use of airspace. These impacts are discussed in the Airspace section. These impacts would be the same in all of the biomes considered in this PEIS.

Water Resources

Laser sensor activation activities would produce the same impacts on water resources in all of the biomes considered in this PEIS. Gases used to generate gas laser sensors are inert and would not impact water resources through atmospheric deposition. Refrigerant 404 would be used to cool gas laser sensors in a closed loop system. In the unlikely event of a spill or leak, the coolant becomes a gas under ambient conditions and would not impact water resources.

Solid-state laser sensors would use either water or deuterium oxide as a coolant. Deuterium oxide is water that contains a significantly higher proportion of deuterium atoms to ordinary hydrogen atoms. The laser coolants would operate within a closed-loop system and are only replaced during general maintenance requirements. The cooling liquids are non-hazardous and would not be expected to impact water resources.

Orbital Debris

Impacts from orbital debris related to space-based laser sensor activation activities would be similar to those described for radars. See Section 4.1.1.3.

4.1.1.6 C2BMC - Computer Terminals and Antennas

As described in Exhibit 4-3, the analysis for computer terminals and antennas is based upon impacts from the activation of the computer terminals and antennas. Impacts from site preparation and construction activities related to computer terminals and antennas are addressed in Support Assets.

Air Quality

Activation emissions from computer terminals and antennas would be limited to exhaust produced by generators. Impacts related to generator emissions are discussed in Support Assets. These impacts would be the same in all of the biomes considered in this PEIS.

Airspace

Activation activities for computer terminals and antennas would have the potential to impact airspace use by utilizing radio transmission frequencies, which may interfere with commercial air traffic control communications. The magnitude of the impact on airspace would depend on the specific location proposed. In accordance with standing regulations, MDA would coordinate radio frequency use and testing with the appropriate air traffic control agencies. A re-radiation tower is a transmission and receiving tower used in conjunction with fiber optic cable to verify the communication link between radar and an interceptor missile. Re-radiation towers can be built to heights of 31 meters (100 feet) and could impact airspace as collision hazards if constructed adjacent to airports and airfields. MDA would coordinate tower siting with the appropriate air traffic control agencies to avoid conflicts with established takeoff and landing patterns.

Biological Resources

Activation activities for land-, sea, and air-based computer terminals and antennas would have the potential to impact biological resources. The level of impact would vary based on the frequency and energy of the signal, and the proximity of the source to sensitive environments or specific threatened or endangered species, as well as the specific location proposed. In accordance with standing regulations, MDA would coordinate radio frequency use and testing with the appropriate resource management agencies.

Re-radiation towers are built to heights of up to 31 meters (100 feet). There is a potential risk of bird collisions with these towers. MDA could mitigate this risk by using highly visible paints and warning lights on the towers.

Space-based computer terminals and antennas would be in GEO and would have no impacts on biological resources.

Geology and Soils

Impacts to geology and soils from computer terminals and antennas would be limited to site preparation and construction activities. These activities are discussed in Support Assets. No impacts to geology and soils are anticipated as a result of the activation of computer terminals and antennas in any biome considered for this PEIS. (U.S. Army Space and Missile Defense Command, 2002d)

Hazardous Materials and Hazardous Waste

Regular maintenance and operation activities at land-based computer terminal and antenna sites would involve a continuous but relatively low level of hazardous materials use. These activities would produce the same hazardous materials and hazardous waste in all of the biomes considered in this PEIS. The anticipated amounts of hazardous materials used at the site are not known but are expected to be small. They could include protective coatings, lubricants and oils, motor and generator fuels, cleaning agents (isopropyl alcohol), backup power batteries, adhesives, and sealants. (U.S. Army Space and Missile Defense Command, 2002d) The use and disposal of these materials would be incorporated into hazardous material and waste management documents, such as an SWPPP and an Oil and Hazardous Substance Discharge Prevention and Contingency Plan. (U.S. Army Space and Missile Defense Command, 2002d) The hazardous materials would be stored in a centralized location for distribution when needed for maintenance. Material Safety Data Sheets would be posted at all locations where hazardous materials are stored or used. A site-specific hazardous materials management plan and an SPCC plan would be developed for the sites. (U.S. Army Space and Missile Defense Command, 2002d) The use and storage of hazardous materials would be in accordance with these regulations and applicable Federal, state, and local regulations. A Pollution Prevention Plan would be implemented for the proposed sites. This plan would control and reduce the use of hazardous materials at the installation site. (U.S. Army Space and Missile Defense Command, 2002d) In addition, the program would comply with any existing base Pollution Prevention Plan. Program personnel would continue to update the system-wide Pollution Prevention Plan, which would outline strategies to minimize the use of hazardous materials over the life cycle of the facilities.

Any hazardous waste generated from the use of these materials would be handled in accordance with appropriate Federal, state, and local regulations. Site-specific hazardous waste management plans would be in place for the operation and maintenance of the sites. If a release were to occur, all hazardous waste would be handled in accordance with appropriate regulations. In addition, a trained spill containment team would manage any release of hazardous waste at the site. (U.S. Army Space and Missile Defense Command, 2002d)

Health and Safety

Activation activities for computer terminals and antennas would have the potential to impact the health and safety of MDA personnel and the general public through the use of radio transmission frequencies and hazardous materials. These activities would produce impacts in all of the biomes considered in this PEIS; however, the impact would vary based on the site selected. The level of impact would vary based on the frequency and energy of the signal, the amount of hazardous materials to be used, and the proximity of the source to MDA personnel or the general public. MDA would train operating

personnel in the operation and maintenance of C2BMC equipment, and would not direct or use C2BMC equipment in a manner that would adversely impact the health and safety of the general public.

Noise

Computer terminal and antenna activation would produce the same type of noise in all biomes considered in this PEIS. Noise impacts associated with activation of computer terminals and antennas would be limited to noise produced by generators. Impacts related to generator noise are discussed in Support Assets.

Transportation

Impacts to transportation due to activation of computer terminals and antennas would be minimal in all biomes considered for this PEIS. Personnel operating and maintaining the components would generate the only traffic as a result of the activation. Personnel would be on site only during operational hours and during routine maintenance activities. (U.S. Army Space and Missile Defense Command, 2003) Impacts as a result of activation would be insignificant.

Water Resources

Additional personnel would be needed for the activation of computer terminals and antennas; these personnel would increase the demand for potable water. Potable water demands associated with the activation activities would be relatively minimal. However, an increase in demand could exceed the capacity of the existing infrastructure. (U.S. Army Space and Missile Defense Command, 2003) This is of particular concern in portions of the Sub-Arctic Taiga, Grasslands, Desert, Tropical, Mountain, and Savanna Biomes where access potable water may be limited. Additional packaged potable water systems could be installed to meet the demands. Site-specific studies should consider the limited potable water supplies in these areas when analyzing the impacts to water resources from the proposed activities. In other biomes including Arctic Tundra, Sub-Arctic Taiga, Deciduous Forest, and Chaparral Biomes, water resources are generally not scarce and therefore, it is unlikely that water demand from additional personnel associated with activation of computer terminals and antennas would exceed the existing capacity. However, there may be site-specific or localized water resource availability issues and these should be considered for any biome.

Operation of the components would have negligible effects on water quality. Implementation of a SWPPP and best management practices would reduce the risk of impacts from erosion and sedimentation to nearby surface waters. Compliance with the SPCC Plan would minimize the potential for accidental spills of hazardous materials and hazardous wastes to affect surface and ground water resources.

Space-based computer terminals would be in GEO and would have no impacts on water resources.

Orbital Debris

Space-based computer equipment could reenter the Earth's atmosphere due to failure, but would not likely result in significant impacts. Impacts from orbital debris related to space-based computer terminal and antenna activation activities would be similar to those described for radars. See Section 4.1.1.3.

4.1.1.7 C2BMC - Underground Cable

As described in Exhibit 4-3, the analysis for underground cable is based upon impacts from the activation of the underground cable.

Air Quality

Air quality impacts associated with underground cable would be limited to ground disturbances resulting from construction activities. These impacts are discussed in Support Assets. Activation activities related to underground cable would not have any impact on air quality in any biome considered for this PEIS.

Airspace

The activation of underground cable would not have any impact on airspace in any biome considered for this PEIS.

Biological Resources

Impacts to biological resources may occur during site preparation, these impacts are discussed in Support Assets. Activation of underground cable would not result in any impacts to biological resources in any biome considered in this PEIS.

Geology and Soils

Impacts to geology and soils would be limited to site preparation activities. Activation of underground cable would not result in any impacts to geology and soils in any biome considered in this PEIS.

Hazardous Materials and Hazardous Waste

Impacts from hazardous materials and hazardous wastes would be limited to site preparation activities. No hazardous materials or wastes would be generated from the

activation of terrestrial and marine underground cable. Therefore, no significant impacts from hazardous materials or hazardous waste would be expected in any biome considered in this PEIS.

Health and Safety

Potential health and safety hazards from site preparation include dust/particulate inhalation, improper chemical handling, and improper use of machinery; these impacts are discussed in Support Assets. No impacts to health and safety would be expected from activation-related activities in any biome considered in this PEIS.

Noise

The activation of underground cable would not produce noise that has the potential to impact sensitive receptors.

Transportation

There would be no significant impact to transportation from activation underground cable in any biome considered in this PEIS. Any necessary repairs to underground cable would require excavation of the cable. These maintenance activities could result in impacts to transportation through movement of equipment and personnel to the repair site. However, repair events would occur infrequently and would require much less activity than that needed for construction. Therefore, impacts to transportation would be insignificant.

Water Resources

Potable water demand for the installation and activation of underground cable would be small. Impacts from the demand for potable water associated with an increase in the number of project related personnel would be as described for Water Resources for Computer Terminals and Antennas. Impacts to water resources may occur during site preparation, particularly in marine environments. These impacts are discussed in Support Assets.

Orbital Debris

The use of underground cable would have no impact on orbital debris.

4.1.1.8 Support Assets - Equipment

Support equipment includes transportation and portable equipment (e.g., automotive, ships, aircraft, rail, generators, cooling units, storage tanks, chemical transfer equipment,

aerospace ground equipment), BMDS Test Bed support equipment (e.g., aircraft, vehicles, ships, mobile launch platforms, operator control units, sensor operations equipment [antenna, electronic equipment, cooling equipment, prime power units]), and weapons basing platform equipment (e.g., Heavy Expanded Mobility Tactical Truck with Load Handling System, Aegis Cruiser, ABL aircraft), as discussed in Section 2.2.4.1 and Section 4.0. This equipment is part of the military services inventory and is used to support mission-related activities.

MDA reviewed the impact analyses and conclusions in previously prepared site-specific NEPA documentation, specifically for the use of transportation of equipment and use of general portable equipment. The use of this type of support equipment has been analyzed in a number of previously prepared documents, including the *Ballistic Missile Defense Programmatic Environmental Impact Statement* (BMDO, 1994); *Ground-Based Midcourse Defense Initial Defense Operations Capability at Vandenberg Air Force Base Environmental Assessment* (MDA, 2003b); *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2003); *National Missile Defense Deployment Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2000); *Theater Missile Defense Extended Test Range Supplemental Environmental Impact Statement* (U.S. Army Space and Strategic Defense Command, 1998a); *Theater Missile Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Strategic Defense Command, 1994a): *Evolved Expendable Launch Vehicle Program Environmental Impact Statement* (U.S. Department of the Air Force, 1998); *Point Mugu Environmental Impact Statement/Overseas Environmental Impact Statement* (U.S. Department of the Navy, 2002b); and *Pacific Missile Range Facility Enhanced Capability Environmental Impact Statement* (U.S. Department of the Navy, 1998). The use of general portable equipment and transport of equipment as defined in the previously prepared NEPA documents would not result in a significant impact.

For example, analyses on generator and transportation emissions conducted at KLC showed that emissions associated with the use of the facility and associated equipment for missile defense activities would be below the 90.7-metric-ton (100-ton) per year criteria pollutant Federal *de minimis* levels that apply to a non-attainment area. However, the use of certain generators would require an amendment to the existing Pre-approved Limit Permit for KLC. (U.S. Army Space and Missile Defense Command, 2003)

In addition, at Vandenberg AFB, procedures are in place so target missile launches would not represent a significant new impact on transportation, including air traffic, vehicular traffic, rail traffic, and marine traffic. (U.S. Army Space and Strategic Defense Command, 1994) Other transportation analyses found that the use of aircraft and commercial ground transportation vehicles to ship equipment from various manufacturing locations to basing locations would result in minor air emissions that were determined to be less than significant.

In many instances, transportation activities can be categorically excluded from further NEPA analysis. In accordance with DoD regulations for implementing NEPA (32 CFR 188), CEQ regulations provide for the establishment of categorical exclusions (40 CFR 1507.3(b)) for those actions, which do not individually or cumulatively have a significant impact on the human environment. Where appropriate, DoD has established such categorical exclusions. For example, infrequent, temporary (less than 30 days) increases in air operations up to 50 percent of the typical installation aircraft operation rate, are categorically excluded.

Review of previously prepared NEPA analyses and existing categorical exclusions have indicated that impacts associated with transportation would not be significant. Transportation activities would be performed in accordance with existing operating procedures and appropriate regulations, as well as in accordance with appropriate NEPA analyses. The shipment or transportation of hazardous and non-hazardous materials would be performed in accordance with applicable DOT standards, as well as established handling and transfer procedures. Proper containment, handling procedures, separation of reactive chemicals, and worker warning and protection systems would be used where necessary. Site-specific spill prevention guidelines, including leak detection and spill control measures, would be followed. However, if the proposed BMDS would increase transportation activities or result in the use of mobile support assets over existing levels or over what has been determined to be categorically excluded, site-specific NEPA analyses might be required.

As discussed above, general portable equipment has been considered in previously prepared NEPA analyses. These analyses demonstrate that the impacts associated with their use would not be significant. The use of some specific element support equipment has also been previously analyzed, and the impacts associated with their use would not be significant.

The use and operation of support equipment would be in accordance with installation-specific requirements that consider impacts on local, regional, and global environmental resources. The ongoing activities that occur at specific installations would be performed in accordance with appropriate Federal, state, and local regulations, and therefore would not be expected to result in a significant impact. Potential operational limitations include restrictions on timing, duration, or operational requirements as dictated through consultations and memorandums of agreement with appropriate regulatory agencies.

The following sections present the impacts associated with operational changes including implementation of new operating parameters for existing support equipment. These operational changes have not been previously analyzed or categorically excluded.

Air Quality

An increase in use of support equipment that results in increased emissions of a criteria pollutant, of a HAP, or of pollutants that affect regional haze could impact air quality. The significance of such impacts on air quality depends on the local or regional regulatory setting as well as the physical climate conditions where the emissions would occur. The regulatory setting includes EPA recognized non-attainment and maintenance areas, areas that have submitted regional haze SIPs to EPA, and locations that have sensitive receptors to HAP emissions. Each of the regulated areas occurs throughout the U.S. and its territories, which include all of the biomes except for the BOA and the Atmosphere.

The physical climate conditions that would affect the intensity and severity of the impact include regions that have periods of air inversions or other climatic conditions that does not permit normal air circulation or turnover to occur. Such conditions occur in the Chaparral, Mountain, and Tropical Biomes.

For areas that fall under a regulated setting through non-attainment and maintenance area designations, regional haze requirements, and their associated SIPs, the regulatory constraints of the location would be addressed in an action specific analysis. The impacts related to the emissions of HAPs would depend on the proximity of sensitive receptors in the impacted area. This type of analysis would require dispersion modeling or other risk calculation methods to evaluate the degree of the impact and identify appropriate mitigation measures.

If emissions are produced that are greater than the *de minimis* values, or if the emission increase would equal or exceed ten percent of the total emission inventory for the entire non-attainment area, then, a Conformity Determination under the Clean Air Act would be required. The *de minimis* thresholds in non-attainment areas are presented in Section 3 in Exhibit 3-3. A review of the state specific SIPs would be performed to identify whether the actions would equal or exceed 10 percent of the total emission inventory.

Airspace

The implementation of new operating parameters for existing support equipment would not impact airspace in any of the biomes considered. An increase in operations of support assets could affect the airspace of the biome where such activities would occur. The impacts on the airspace in the various biomes would be insignificant because all operations involving support equipment would be performed in accordance with existing airspace use requirements.

Biological Resources

Operational use changes could impact biological resources in the various biomes where such activities would occur. The impacts on biological resources would result from emissions of criteria pollutants and HAPs, equipment emitting EMR or radio frequencies, operations within sensitive environments (wetlands, critical habitat, essential fish habitat, wild and scenic rivers, or other protected natural resource areas), and debris from missile intercepts, catastrophic failure, or flight terminations. Methods employed to reduce impacts on natural resources including scheduling and duration considerations, as well as informal and formal consultations with regulatory agencies would be expected to reduce the potential for impact below significant levels. Should the impacts affect a threatened or an endangered species or its habitat, essential fish habitat, jurisdictional wetlands, or another regulated resource then in addition to analysis under NEPA and other applicable laws (Clean Water Act, Endangered Species Act), regulatory agency consultation would be required. The appropriate Federal agency must be consulted under Section 7 of the Endangered Species Act when site specific analysis indicates the continued existence of a threatened or endangered species is likely to be jeopardized.

Geology and Soils

In most biomes an operational use change would not impact geology or soils. However, in the Artic Tundra and Sub-Arctic Taiga Biomes, construction or modification activities have the potential to alter the condition of the permafrost that covers the biome. In addition, these biomes may be subject to earthquakes.

When appropriate, construction would incorporate seismic design parameters consistent with the critical nature of the facility and its geologic setting. In biomes with floodplains and the coastal environments, siting of facilities should consider the proximity to 100-year floodplains and maximum probable tsunami wave run-up areas.

Hazardous Materials and Hazardous Waste

An operational use change could result in an impact from the use of hazardous materials and the generation of hazardous waste, if such materials were used in the process. Such impacts could affect the biome where the action would occur. Should an operational use change result in new hazardous materials or hazardous waste, such items would be handled in accordance with specific protocols and appropriate regulations. Federal military ranges have established procedures in accordance with Federal regulations to ensure proper handling and use of these hazardous materials. These procedures would be reviewed to ensure that they address the hazardous materials that would be used. An evaluation of the potential impacts would occur if operational changes would utilize hazardous materials or generate hazardous waste not addressed in relevant specific protocols. All hazardous waste generated would be disposed of in accordance with

applicable laws and regulations. The personnel involved in hazardous material operations would be trained in the appropriate procedures, use appropriate personal protective clothing, and be up-to-date on any specialized training in hazardous material handling, spill containment and cleanup, or other hazardous material activities

Health and Safety

An operational use change would have the potential to impact health and safety. Impacts on health and safety are not associated with particular biomes; rather they are associated with the processes and activities that would be implemented under a specific action. The personnel who would operate equipment would be familiar with standard operating procedures and would receive specific equipment training as necessary. In addition to adhering to existing procedures, all activities would be performed in accordance with the health and safety requirements of the specific installation or test range, which are designed to protect public heath and safety.

Noise

Operational changes could impact ambient noise levels. Such impacts would affect the biome where the action would occur, and include new sources of noise or new operations that would alter the intensity, frequency, or duration of a noise-emitting source. The severity of such an impact would be related to the proximity of sensitive receptors to the noise source. Receptors include DoD workers, the general pubic, noise sensitive areas (housing developments, schools), and wildlife including critical habitat. An action- or site-specific study, in accordance with NEPA, would be performed for activities that may impact noise. Such a study would identify the receptors, quantify the impact, and recommend mitigation measures.

Transportation

Operational use changes could result in impacts to transportation; however, these impacts would not be significant. Mobile equipment would be used for a limited time during a test event, or would be used to transport supplies and components to and from various facilities. As indicated in Section 4.1.1.2, the use of support equipment during launch and post-launch activities (debris recovery) would not be expected to significantly impact transportation.

Water Resources

Because operational use changes of existing infrastructure would occur at existing facilities specifically designed for the support equipment in accordance with all relevant and applicable regulations, such activities would not impact water resources in any of the biomes. Operational use changes that would result in impacts to areas not specifically

designed for use of the support equipment could be subject to additional environmental review.

Orbital Debris

No impacts from orbital debris would occur as a result of an operational use change of support equipment.

Space-based equipment (satellites) could reenter the Earth's atmosphere due to failure, but would not likely result in significant impacts. Most objects break up and often vaporize under the intense aerodynamic forces and heating that occur during reentry. Most of the objects which reenter would fragment and burn in the upper atmosphere and would make only negligible changes in its chemical composition. Even if an object does survive reentry, only one third of the Earth is land area, and only a small portion of this land area is densely populated. The chance of hitting a populated land area upon reentry would be small. (SDIO, 1992)

4.1.1.9 Support Assets - Infrastructure

The following discussion of support asset infrastructure includes BMDS Test Bed infrastructure (test ranges and associated facilities), non-BMDS Test Bed Infrastructure (radar and tracking stations), and weapons basing platform infrastructure (missile silos) as discussed in Section 2.2.4.1 and Section 4.0. This equipment is part of the military services inventory and is used to support mission-related activities.

MDA reviewed the impact analyses and conclusions in previously prepared site-specific NEPA documentation, specifically for the use and modification of existing infrastructure, repair, maintenance, and sustainment. These activities have been analyzed in a number of previously prepared documents, including the *Ballistic Missile Defense Programmatic Environmental Impact Statement* (BMDO, 1994); *Ground-Based Midcourse Defense Initial Defense Operations Capability at Vandenberg Air Force Base Environmental Assessment* (MDA, 2003b); *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2003); *National Missile Defense Deployment Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2000); *Theater Missile Defense Extended Test Range Supplemental Environmental Impact Statement* (U.S. Army Space and Strategic Defense Command, 1998a); *Theater Missile Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Strategic Defense Command, 1994a): *Evolved Expendable Launch Vehicle Program Environmental Impact Statement* (U.S. Department of the Air Force, 1998); *Point Mugu Environmental Impact Statement/Overseas Environmental Impact Statement* (U.S. Department of the Navy, 2002b); and *Pacific Missile Range Facility Enhanced Capability Environmental Impact*

Statement (U.S. Department of the Navy, 1998), and *Mobile Sensors Environmental Assessment (MDA, 2005).*

These previous analyses show that potential impacts from infrastructure modification include construction-related impacts that could result from PM and construction equipment emissions. These emissions would be short-term, and would only affect those receptors close to construction areas. Activities that would continue in existing facilities at government and contractor installations would not result in any significant impacts. All activities would follow applicable regulations and established guidelines and management practices. Any increased water demands or demands on other utilities (electricity, natural gas, waste water disposal) that could be readily met by existing supply and treatment systems, groundwater withdrawals, or alternative sources, would not result in significant environmental impacts. (BMDO, 1994)

In many instances, use and modification or maintenance and sustainment of existing infrastructure is categorically excluded from further NEPA analysis. For example, per 32 CFR Part 651, Appendix B, construction of an addition to an existing structure or new construction on a previously undisturbed site is categorically excluded if the area to be disturbed has no more than five cumulative acres of new surface disturbance, and the construction does not individually or cumulatively have a significant effect on the human environment.

Previous analyses show that the impacts of such activities in support of the BMDS would not be significant because such activities would be performed in accordance with existing regulations. However, if proposed BMDS activities would result in major modification of existing infrastructure or major changes in use, site-specific NEPA analysis would be required. Additionally, changes in the level of human services used to support BMDS activities would be analyzed in site-specific NEPA analysis. In accordance with 40 CFR Part 1508.14, the site-specific NEPA analysis would address the socioeconomic impacts that are interrelated with impacts on the natural and physical environment.

The following sections present the impacts associated with site preparation and construction, including the modification of existing infrastructure, which are not sufficiently covered in previous NEPA analyses or categorically excluded.

Air Quality

The development of new or the major modification of existing infrastructure could impact air quality. Such impacts would affect the biome where the action would occur, and would result from site preparation and construction activities. Estimates of air quality impacts from construction are based on building square footage, acreage disturbed, and duration of construction, as well as general meteorological and soil information. Construction would require ground disturbances resulting in PM_{10} and

fugitive dust impacts. In 1995, EPA estimated that ground-disturbing activities cause the release of 1.08 metric tons (1.2 tons) of uncontrolled fugitive dust emissions per 0.4 hectare (1 acre) per month of ground-disturbing activity. (U.S. Army Space and Missile Defense Command, 2003) An estimated 50 percent of fugitive dust emissions consist of PM_{10}, though a more accurate percentage is based on the makeup of the local soil. (U.S. Army Space and Missile Defense Command, 2003) Standard fugitive dust reduction measures would be implemented when necessary. Water trucks might be used to dampen soil to minimize dust by releasing water or another biodegradable dust suppressant. The speed of construction vehicles would be restricted to limit soil separation into dust, and any soil stockpiled as fill material would be covered until use to prevent moisture evaporation and separation induced by wind. (MDA, 2003b)

The use of construction equipment would result in emissions of CO, NO_X, VOCs, and oxides of sulfur. Potential construction equipment emissions would be determined on a site-by-site basis by using emission factors from various sources including EPA. Proper tuning and preventive maintenance of construction vehicles would serve to minimize exhaust emissions and maximize vehicle performance. Construction would be conducted in accordance with all applicable laws and regulations. While the construction would cause an increase in air pollutants, it is assumed that the impact would be both temporary and localized. Once construction ceased, air quality would return to its former level.

Airspace

Site preparation and construction would not have any impact on airspace because all activities would take place on the ground and would not involve any closures or restrictions on airspace use. Modifications to infrastructure not previously addressed in NEPA analyses would not have any impact on airspace because the modifications would not result in any closures or restrictions on airspace use.

Biological Resources

Site preparation and construction could impact biological resources in the various biomes where such activities would occur. Vegetation, wildlife, and specific sensitive habitats could be affected based on the specific location of the development or modifications. The construction and expansion of buildings and roads could result in the clearing of vegetation and adverse impacts on wildlife near the activities. Site preparation activities may require pouring of pavement or spreading of gravel to facilitate mobility of the construction vehicles. Site preparation and construction activities that generate dust, irritable pollutants and noise, might temporarily disturb nearby wildlife, while permanent structures would result in the loss of habitat, displacement of wildlife, increased stress, and disruption of daily/seasonal behavior. (U.S. Army Space and Missile Defense Command, 2002d) Construction of infrastructure could lead to increased surface runoff. The combination of increased noise levels and human activity would likely displace some

small mammals and birds that forage, feed, nest, or have dens within a 15-meter (50-foot) radius of such activities. (U.S. Army Space and Missile Defense Command, 2002d) Whenever possible, construction and site preparation activities would occur on or near previously disturbed areas.

In Artic Tundra, Chaparral, and Tropical Biomes site preparation and installation activities for underground cable could impact species that rely on the shore environment including species of pinnipeds, shorebirds, waterbirds, otters and whales, and sea turtles. The installation of marine underground cable through near shore areas and through shoreline and tidal areas could disturb the habitats that these species depend on.

Pinnipeds and shorebirds are easily startled by noise and movement. (U.S. Army Space and Missile Defense Command, 2003) Site preparation and construction activities could cause a range of behavioral responses from heightened alertness to abandonment of favorable habitat areas. (U.S. Army Space and Missile Defense Command, 2003) It may also be possible for site preparation and construction noise to lead to nest abandonment or changes in migration routes. The severity of the response would depend on the intensity (noise level, area of the disturbance) of the installation project, the proximity to the pinniped and shorebird habitats, and the sensitivity of the species. Site-specific analyses would more accurately assess the potential impacts of the proposed activities on biological resources.

Shorebirds are very sensitive to noise during the nesting season. (U.S. Army Space and Strategic Defense Command, 1998a) The flushing of shorebirds from nests could result in the exposure of eggs to excess cold/heat and to predation.

Construction activities would be planned and sited to avoid regulated habitats (jurisdictional wetlands, critical habitat, or essential fish habitat). Should the impacts affect a threatened or an endangered species or its habitat, essential fish habitat, jurisdictional wetlands, or another regulated resource then in addition to analysis under NEPA, compliance with other laws (e.g., Clean Water Act, Endangered Species Act, Marine Mammal Protection Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act), and regulatory agency consultation would be required. The appropriate Federal agency must be consulted under Section 7 of the Endangered Species Act when site specific analysis indicates the continued existence of a threatened or endangered species is likely to be jeopardized.

Environmentally sensitive habitats could be impacted by site preparation and construction activities for underground cable. Trenching through coral reef areas would adversely impact the reef. Coral reefs are slow developing habitats that are very sensitive to changes in water quality. The trenching activity would disturb seafloor sediment and would temporarily increase the turbidity of the water column. This would lower the solar light penetration that the reefs depend on for growth and energy. (University of the

Virgin Islands, 2003) In addition, the trenching activities would break up existing reef. Studies have shown that coral reefs are very sensitive to physical disturbances. Reefs that have been physically damaged can be more susceptible to disease. (University of the Virgin Islands, 2003) Underground cable site preparation and construction activities would comply with EO 13089 and would be avoided to the extent possible in coral reef areas.

The marine underground cable installation activities could startle and temporarily displace whales and sea otters. However, these species would likely return once the installation is complete. Installation activities that occur in freshwater and tidal streams could cause siltation and disturbance of maturation and feeding habitats for some species of fish. (U.S. Army Space and Strategic Defense Command, 1994a) Site-specific studies should analyze the potential impacts of the proposed activities on the biological resources of the affected environment.

Studies have shown that artificial light can affect sea turtle behavior. (U.S. Army Space and Strategic Defense Command, 1998a) Artificial light associated with construction sites could confuse nesting sea turtles causing abandonment of nesting sites. Artificial lights could also confuse hatchling turtles by causing them to move in circles and reducing their chances of making it safely to the ocean. (U.S. Army Space and Strategic Defense Command, 1998a) Trenching and backfilling in sea turtle nesting areas could disturb buried nests or cover the nests with a sand layer too deep for the hatchlings to escape. Because sea turtle and shorebird nesting is a seasonal process, construction activities could be coordinated to avoid nesting seasons. Site-specific analyses would more accurately assess the potential impacts of the proposed activities on biological resources.

Geology and Soils

Typical construction activities that could adversely affect local geology and soils include cut-and-fill operations, paving operations, compaction, mixing, grading, and general soil erosion. Exposed soils become dry and porous and shift easily resulting in increased erosion rates. Paving operations would degrade the quality of the soil as it mixes with tar and reduces permeable surfaces. Best Management Practices[53] would be implemented to minimize negative short-term effects of clearing and grading activities during site preparation, as well as excavations and grading for connecting infrastructure, roadways and parking. Any construction activities greater than five-acres would be required to obtain an NPDES storm water run-off permit, which typically specifies the Best Management Practices for the entire construction site. Except for localized soil compaction in the construction area, long-term impacts to the soils resulting from

[53] A best management practice is a business function, process, or system considered superior to all other known methods, that improves performance and efficiency in a specific area. (Office of the Secretary of Defense Comptroller iCenter, 2004)

construction would not be anticipated. (U.S. Army Space and Missile Defense Command, 2003)

Site preparation and construction could impact the geology and soils of the Artic Tundra and Sub-Arctic Taiga Biomes. Such impacts would be related to activities that alter the condition of the permafrost that covers the biome.

Whenever possible, construction and site preparation activities would occur on or near previously disturbed areas to limit or reduce disturbance of undisturbed areas. Construction would incorporate seismic design parameters consistent with the critical nature of the facility and its geologic setting. In biomes with floodplains and the coastal biomes, facilities should be constructed outside of existing 100-year floodplains and beyond established limits for tsunami wave run-up for a maximum probable tsunami event. (U.S. Army Space and Missile Defense Command, 2003)

Hazardous Materials and Hazardous Waste

Site preparation and construction and development could result in an impact from the use of hazardous materials and the generation of hazardous waste. Such impacts would affect the biome where the action would occur. Based on the type of infrastructure the potential hazardous wastes that would be generated during construction and site preparation include solvents, cutting fluids, acetylene, and various paint products, used acetone, motor fuels, heating fuels, waste oils, hydraulic fluids, used batteries, and waste antifreeze. Small quantities of solvents are typically used for degreasing or other cleaning activities. Residual solvents would be disposed of as hazardous waste along with contaminated materials (e.g., rags). Hazardous waste disposal would take place at permitted sites equipped to handle the safe and proper disposal of such materials.

A Pollution Prevention Plan would be implemented for new or major modification to existing infrastructure. This plan would control and reduce the use of hazardous materials at the site. (U.S. Army Space and Missile Defense Command, 2002d) In addition, the program would comply with any existing base Pollution Prevention Plan. Program personnel would continue to update the system-wide Pollution Prevention Plan, which would outline strategies to minimize the use of hazardous materials over the life cycle of the facilities.

Renovation and site preparation activities may generate wastes that include asbestos-containing material and lead-based paints. Prior to any existing building modification or demolition, surveys would be conducted to determine if these materials are present in the modification area. A licensed asbestos abatement contractor, in accordance with state and Federal regulations, would perform renovations in these instances. All removed asbestos would be disposed of in a solid-waste landfill designed to receive asbestos-containing material. Management and abatement of asbestos and lead-based paint at

selected sites would be compliant with management plans such as a Lead-Based Paint Management Plan, an Asbestos Management Plan, an Asbestos Operating Plan, as well as the applicable legal requirements. (U.S. Army Space and Missile Defense Command, 2003)

Health and Safety

Site preparation and construction could impact health and safety. Impacts on health and safety are not associated with particular biomes, rather are associated with the processes and activities that would be implemented under a specific action. Potential health and safety hazards from site preparation and construction activities include dust/particulate inhalation, improper chemical handling, and improper use of machinery. General safety procedures would be followed to protect construction workers, base personnel, and the general public during site preparation and construction activities. No impacts to human health and safety from site preparation and construction activities would be expected, if all applicable legal requirements are met.

Construction activities would produce physical hazards such as noise, electrical, heavy-moving equipment and machinery, welding, and earth moving and digging activities. Health and safety procedures would be compliant with appropriate management plans and applicable regulations. Any waste would be collected and segregated as non-hazardous, hazardous, and possibly special wastes for proper disposal in accordance with applicable legal requirements.

The design of new facilities or the modification of exiting facilities would incorporate measures to minimize the potential for and impact of health and safety related accidents. Operating procedures and training would be instituted to minimize the potential for and impact of releases of hazardous materials. Specific health and safety plans would be developed including evacuation plans, and notification of local and offsite emergency response as required.

Noise

Site preparation and construction and development of new or the major modification of existing infrastructure could impact ambient noise levels. Such impacts would affect the biome where the action would occur, and would be related to construction activities or new operations that would alter the intensity, frequency, or duration of a noise emitting source, and would depend upon the sensitivity of the receptor to the sound generated. Receptors include workers, wildlife, and the public in the proximity of the noise source. Site preparation and construction activities would be comparable to common construction activities. The amount of noise generated would depend upon the amount and type of construction being done. Construction on existing facilities would likely be minor; construction of new infrastructure could result in larger impacts. Personnel that may be

exposed to loud noises would be required to wear hearing protection, such as earplugs and earmuffs, which would reduce the noise levels to prescribed health and safety levels. An action or site-specific study would be performed for activities that may increase noise levels. Such a study would identify sensitive receptors and their locations, quantify the impact, and recommend mitigation measures.

Transportation

Site preparation and construction activities may require the use of heavy machinery the transportation of which could cause changes in the amount of congestion on the existing road network. In addition, an influx of construction workers may change the level of demand for access to the existing roadways. In general, these activities would not be expected to cause a significant impact on transportation. However, if these changes in demand and congestion demonstrate the potential for significant impact, site specific analyses would be prepared.

Water Resources

Site preparation and construction could impact water resources by increasing operations resulting in a discharge of wastewater. Modifications or construction activities would follow site-specific protocols for storm water and ground water pollution prevention, and would require application for appropriate permits and development of pollution prevention plans for protection of water resources on- and off-site. For new installations, site-specific documentation would be required to determine potential effects of construction and operation activities on surface water, ground water, and floodplains. The impacts on water resources would be analyzed in accordance with NEPA and other appropriate regulations, including the Clean Water Act and any applicable international or foreign legal requirements for activities outside of the U.S.

Orbital Debris

No impacts from orbital debris would occur as a result of site preparation and construction.

4.1.1.10 Support Assets - Test Assets

The following discussion of support asset test assets include assets of the BMDS Test Bed (test sensors and communications) and assets that are used to support the BMDS Test Bed (targets, countermeasures, and simulants) as discussed in Section 2.2.4.1 and Section 4.0. This equipment is part of the military services inventory and is used to support mission-related activities.

MDA reviewed the impact analyses and conclusions in previously prepared site-specific NEPA documentation, specifically for the development and use of test assets. These activities have been analyzed in a number of previously prepared documents, including the *Ballistic Missile Defense Programmatic Environmental Impact Statement* (BMDO, 1994); *Ground-Based Midcourse Defense Initial Defense Operations Capability at Vandenberg Air Force Base Environmental Assessment* (MDA, 2003b); *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2003); *National Missile Defense Deployment Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2000); *Theater Missile Defense Extended Test Range Supplemental Environmental Impact Statement* (U.S. Army Space and Strategic Defense Command, 1998a); *Theater Missile Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Strategic Defense Command, 1994a): *Evolved Expendable Launch Vehicle Program Environmental Impact Statement* (U.S. Department of the Air Force, 1998); *Point Mugu Environmental Impact Statement/Overseas Environmental Impact Statement* (U.S. Department of the Navy, 2002b); and *Pacific Missile Range Facility Enhanced Capability Environmental Impact Statement* (U.S. Department of the Navy, 1998).

MDA also reviewed existing categorical exclusions to determine which activities associated with the development and use of test assets are categorically excluded from further NEPA analysis.

The activities previously analyzed and those that are categorically excluded include the development, manufacturing, and assembly of components and component prototypes at existing DoD and non-DoD (contractor) facilities.

For example, the *Theater High Altitude Area Defense Initial Development Program Environmental Assessment* (U.S. Army Space and Strategic Defense Command, 1994c) found that all manufacturing and engineering activities would be accomplished in existing facilities and would use personnel routinely engaged in these types of activities. The facilities and personnel utilized would operate at levels and intensities similar to current conditions, which would result in no significant impacts. In addition, the EA found that manufacturing and engineering various missile components would involve the use of various hazardous materials. Because the facilities would comply with the CCR, Title 22, Division 4, Environmental Health; Title 40 CFR, Parts 260-280, and the RCRA, as well as specific facility guidelines that describe procedures for items such as correct storage, labeling, and transportation of hazardous waste, such activities would be not significant.

Similarly, because the manufacturing and assembly of the BMDS components would occur at existing facilities, would follow established standard operating procedures to protect worker and public safety, and would be performed in accordance with all appropriate and relevant laws and regulations, the impacts associated with manufacturing

would not be significant. However, should an activity require new or major modification to an existing DoD-owned or operated manufacturing facility, or require the preparation of new assembly standard operating procedures, action-specific NEPA analysis would be conducted.

The use of test assets in various configurations has been considered in previous NEPA analyses. Most of this equipment is sensor, tracking (optical, laser, and radar systems), and communications systems. The use of such equipment is both installation- and scenario-specific. Previous analyses have shown that impacts associated with the use of support equipment for test assets would not be significant.

The use of targets and their boosters, target test objects, simulants and countermeasures at some specific locations has been considered in previous NEPA analyses. For example, the *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2003), shows that the Peacekeeper target missile would contain less solid rocket fuel and would produce lower exhaust emissions that existing target missiles. In addition, modeling of target missiles to include dual launches demonstrated that the level of HCl emitted would be below the 1-hour Air Force standard, but would exceed the peak HCl standard for a short duration. The emission levels for both CO and Al_2O_3 were determined to be within NAAQS and California AAQS; therefore, the nominal launch of a single Peacekeeper target missile is anticipated to remain within NAAQS, California AAQS, and Air Force Standards. Previous analyses show that the impacts associated with the use of targets and their boosters for activities associated with the proposed BMDS would have no significant impacts.

The use of drones as targets has been considered in previous NEPA analyses and has not been found to result in significant impacts. Drones are used to mimic the heat and radar returns of missiles and aircraft, and can use various countermeasures to deceive interceptors. The potential for impacts from the use of drones is influenced by the specific flight pattern to be flown and intercept altitude, if appropriate. Site specific analysis including debris analysis might be required for future proposed actions using drones.

The development and use of individual test assets (e.g., sensors, targets, and drones) have been analyzed in site-specific NEPA documents, which found no significant impacts from such activities. The development and use of those test assets as defined in the previous site-specific NEPA documents would not result in a significant impact. The combined impact associated with test assets and the other BMDS components was analyzed in Section 4.1.2, Test Integration. The following sections present the impacts associated with the use of simulants and countermeasures.

Air Quality

The development and use of simulants, countermeasures, and drones could impact air quality in the biome where the action would occur. The prelaunch activities where the simulants, countermeasures, and drones are assembled and prepared for use would result in the emissions of Federal or state-listed criteria pollutants, as well as potential HAP emissions. The HAPs that may be released would depend on the chemical composition of the simulant or countermeasure, or the materials associated with the drones. The use of simulants, countermeasures, and drones during test events would result in emissions to the air; however, based on the parameters of the specific test, the emissions may be at an elevation above 914 meters (3,000 feet) and would not affect ground level air quality. Based on the chemical composition and volume of the simulant, or the composition and volume of volatile substances in the countermeasure component or drone, the emissions above 914 meters (3,000 feet) may impact air quality in terms of ozone depletion (particularly in the upper troposphere and stratosphere), acid rain, and global warming. Existing impact analyses prepared in accordance with NEPA and standard operating procedures would be reviewed to ensure that the activities would not result in a significant impact. Site-specific environmental analysis would be completed to evaluate potentially significant impacts.

Airspace

The use of delivery systems (boosters) for the simulants and countermeasures, as well as the simulants and countermeasures themselves could impact airspace of the biome where the action would occur. The operating altitudes, lateral orientation, specific type of airspace, and the region of influence are the parameters of specific test scenarios that influence the degree of the impact on airspace. The use of simulants and countermeasures may increase the duration and severity of impact on a particular airspace. The impacts of specific simulants and countermeasures on airspace would be reviewed in accordance with NEPA.

Biological Resources

The development and use of simulants and countermeasures could impact biological resources of the biome where the action would occur. Should the impacts affect a threatened or endangered species or its habitat, essential fish habitat, or jurisdictional wetlands, or another regulated resource then in addition to analysis under NEPA, compliance with other applicable laws (e.g., Clean Water Act, Endangered Species Act, Marine Mammal Protection Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act), as well as regulatory agency consultation could be required.

Geology and Soils

The development and use of simulants and countermeasures would not impact geology; however, such activities could impact soils in the biome where the action would occur. The impact would result from the deposition of the simulants or countermeasures on the soil. The severity of the impact would be based on the composition of the simulant or countermeasure. The impacts related to the use of new simulants or countermeasures would be evaluated as necessary in accordance with NEPA.

Hazardous Materials and Hazardous Waste

The development and use of simulants and countermeasures could result in an impact from the use of hazardous materials and the generation of hazardous waste. A wide variety of hazardous materials may be used in the development of simulants and countermeasures including solvents, and toxic metals and substances. No radioactive materials would be used in the development and use of simulants and countermeasures. The development and use of specific simulants and countermeasures would include a life cycle analysis of potential impacts, including specific decommissioning activities for any hazardous materials. Hazardous materials or hazardous waste associated with the use of a simulant or countermeasure would be handled in accordance with installation and range specific protocols and appropriate regulations. Federal military ranges have established procedures in accordance with Federal regulations to ensure proper handling and use of these hazardous materials. These procedures would be reviewed to ensure that they address the appropriate hazardous materials. An evaluation of the potential impacts in accordance with NEPA and other relevant regulations would occur if the use of a simulant or countermeasure would utilize hazardous materials or generate hazardous waste not addressed in installation specific protocols. All hazardous waste generated would be disposed of in accordance with appropriate state and Federal regulations. The personnel involved in hazardous material operations would be trained in the appropriate procedures and would use appropriate personal protective clothing and would be up-to-date on any specialized training in hazardous material handling, spill containment and cleanup, or other hazardous material activities.

Health and Safety

The development and use of simulants and countermeasures could impact health and safety. Impacts on health and safety are not associated with particular biomes; rather they are associated with the processes and activities that would be implemented under a specific action. Health and safety impacts would be commensurate with the chemical composition of the simulant and the operating parameters involved with the use of simulants and countermeasures. New standard operating procedures that address safe handling and operational requirements to protect public health and safety would be developed for new or modified simulants and countermeasures. Such plans would

address health and safety issues for general operation and handling, as well as health and safety operations for system and operational testing and failures. The personnel who would operate and handle such equipment would be familiar with the standard operating procedures and would receive specific training as necessary. These actions would be performed in accordance with health and safety requirements of the specific installation or test range, which are specifically designed to protect public heath and safety.

Noise

The development and use of simulants or countermeasures would not impact noise within any biomes because these activities do not generate noise. The noise associated with the delivery system (i.e., booster) of a simulant or countermeasure is presented in Weapons – Interceptors.

Transportation

The development and the use of simulants would not impact transportation. As indicated in Section 4.1.1.2, short-term road closures along launch trajectories, the issuance of NOTAMs and NOTMARs to notify pilots and mariners of area closures, and debris recovery activities would not be expected to impact transportation.

Water Resources

The development and use of simulants and countermeasures could impact water resources in the biome where the action would occur. The severity of the impacts would depend on the chemical composition of the simulant or countermeasure. Impacts would occur from the deposition of simulants and countermeasures on surface waters, or from simulants migrating through soils to ground water. The disposal of simulants or countermeasures would follow appropriate protocols for the composition of the simulants and countermeasures. Prior to using simulants or countermeasures that may impact water resources, the impacts related to the specific chemical composition and operational testing environment would be analyzed in accordance with NEPA. Compliance with Federal and state regulations also would be required.

Orbital Debris

If countermeasures are used and remain on-orbit, they have the potential to disrupt or damage other space-based assets (e.g., communication satellites). However, orbiting objects lose energy through friction with the upper atmosphere and various other orbit perturbing forces. Over time, objects including countermeasures, may drop into progressively lower orbits and may eventually fall to Earth. As the object’s orbital trajectory draws closer to Earth, it speeds up and outpaces objects in higher orbits. Once

the object enters the measurable atmosphere, atmospheric drag will slow it down rapidly and cause it either to burn up or deorbit and fall to Earth.

4.1.2 Test Integration

Test integration considers the range of integrated testing activities the BMDS proposes to implement to transition from the testing of individual components to the evaluation of how they will work together and perform as the BMDS. Modeling, simulation, and analysis; MDIE; and integrated missile defense wargames are virtual tests (modeling and computational analyses) or software compatibility and communication tests that would be conducted within existing laboratory or test facilities. Because of the nature of these tests, no significant impacts would occur in any biome. However, activities associated with GTs and SIFTs would have the potential for environmental impacts.

GTs test components for interoperability. Such tests would assess and evaluate the C2BMC integration of the various components as well as the assimilation and use of the various sensors tracking system data. No laser weapons would be activated and no interceptors would be launched during GTs. To conduct these tests, multiple sensors and C2BMC components could be used from land-, air-, sea-, and space-based operating environments that would coordinate the control and transfer of information between weapons based on land, sea, and in the air. These sensors and C2BMC components could be activated from within the same biome or across several biomes.

For purposes of this analysis, two representative scenarios that could be used for SIFTs were considered. These two scenarios involve similar activities (launches of targets, use of multiple sensors, and use of land-, sea-, and air-based weapons); however, they differ in number of target launches and number of weapons used. Both scenarios may be used to support the proposed BMDS and are analyzed in this PEIS.

SIFT Scenario 1 – Single Weapon with Intercept represents the simplest SIFT and would include the launch of a single target and use of a single weapon component to intercept the target. This scenario would use multiple sensors and C2BMC components as described for GTs. Under SIFT Scenario 1, the launch of the target and the activation of a laser or launch of an interceptor may occur within the same biome (e.g., all within the Desert Biome) or may involve multiple biomes (e.g., target launch from the Tropical Biome and laser activation or interceptor launch in the BOA). As BMDS capabilities are proven, a second SIFT Scenario is envisioned that would build upon SIFT Scenario 1.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts would include the launch of up to two targets. For each target launch, more than one weapon component (land-, sea-, or air-based) would be able to engage or “take a shot” at the target. Dual-target or interceptor launches would occur within seconds or minutes of each other. As with SIFT Scenario 1, numerous sensor components also would acquire the target and relay tracking

data. Under this test scenario, the two targets may be launched from one biome and the weapons may be activated or launched from the same or different biomes.

Environmental Consequences

Component testing would continue to occur under Alternative 1. These component tests would be conducted in addition to the proposed System Integration Tests. SIFTs would generally be designed around planned component flight tests. However, MDA may schedule additional tests that are not part of previously planned flight tests. Therefore, the total number of target and interceptor launches and laser, sensor, and C2BMC activation events would increase when compared to the No Action Alternative. This would increase the total number of tests, and thus the magnitude of environmental impacts.

The environmental consequences associated with the use of BMDS components under Alternative 1 are analyzed in Section 4.1. Impacts from activities that are discussed earlier in this PEIS will not be discussed in this section. Therefore, the analysis of System Integration Tests will focus on those environmental impacts that are unique to these types of tests. For this programmatic analysis, a qualitative impact assessment was completed for each resource area because specific System Integration Test parameters have not been developed that would provide quantitative values.

The activities associated with each type of System Integration Test analyzed in this PEIS include

- **Integrated GTs**. The activation of multiple sensors and C2BMC components, and passive activation of weapons (e.g., powering the tracking and communication aspects of the weapons system but not firing the weapon) within the same biome or across several biomes, which would coordinate the control and transfer of information between land-, sea-, and air-based weapons.

- **SIFT Scenario 1 – Single Weapon with Intercept**. The activation of multiple sensors and C2BMC components within the same biome or across several biomes coupled with the launch of one target and the activation of a laser or launch of an interceptor, and the debris from an intercept. Because the impacts associated with the use of multiple sensors and C2BMC components is discussed for GTs, this portion of the impacts analysis will not be repeated for this scenario.

- **SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts**. The activation of multiple sensors and C2BMC components within the same biome or across several biomes coupled with the launch of up to two targets from the same biome or different biomes, the activation or launch of multiple weapons in the same biome or multiple biomes, and the debris from each intercept. Because the impacts associated with the

use of multiple sensors and C2BMC components are discussed for GTs, this portion of the impacts analysis will not be repeated for this scenario.

4.1.2.1 Air Quality

Integrated GTs

The emissions from generators required to power sensor and C2BMC systems could impact air quality. However, these generators would only be operated for a short time and the emissions associated with the activation of one generator would be a small fraction of *de minimis* thresholds. Activating multiple generators in a single biome or across multiple biomes would not have a significant impact on air quality.

The activation of radars, infrared, and optical sensors would not impact air quality. Leaks of inert gases, such as helium, N_2, and CO_2, from gas propellant laser sensors could occur; however, a leak of these gases to the atmosphere would be insignificant relative to ambient oxygen concentrations. There are no air emissions associated with the activation of solid-state lasers; therefore, no impacts to air quality would be expected. An increase in the number of laser sensors activated during GTs would not have a significant impact on air quality regardless of whether the sensors were located in the same or multiple biomes.

SIFT Scenario 1 – Single Weapon with Intercept

In addition to the impacts presented under GTs, the emissions from SIFT Scenario 1 would include emissions from activation of lasers and launches. The primary exhaust products of boosters and lasers would be as described for weapons components. An intercept would result in the release of gases and PM.

For a target launch and the activation of a laser or launch of an interceptor occurring in the same biome, the emissions from laser activation and launches combined with the release of gases and particulates from an intercept could impact air quality. Exhibit 4-11 shows the combined emission products from the launch of a representative target and interceptor within the same biome. Exhibit 4-12 shows the emission products from the launch of a representative target and the activation of a laser within the same biome. Emissions from launch activities and laser activation would not be expected to result in significant impacts to air quality. EPA uses six criteria pollutants as indicators of air quality, including ozone, CO, NO_2, SO_2, PM, and lead, and has established a maximum concentration for each, above which adverse effects on human health may occur. Of these pollutants, only CO is emitted during the launch of targets and the launch or firing of weapons. The *de minimis* level for CO is 91 metric tons (100 tons) per year. As shown in Exhibits 4-11 and 4-12, CO levels for the launch of a target and a launch of an interceptor would be only three percent of the *de minimis* level. The CO levels for the

launch of a target and the activation of a laser also would be less than two percent of the *de minimis* level. The magnitude of potential impacts from other emissions from launch and laser activation would depend on the biome in which the activities took place and would be analyzed in site-specific analyses. Impacts to air quality from laser activation and launches occurring in different biomes would not have the additive impacts of activities occurring within the same biome.

Exhibit 4-11. Emission Products from Launches of Representative Targets and Interceptors in metric tons (tons)

Emission Product	Target	Interceptor	Total
Al_2O_3	2.30 (2.54)	3.01 (3.32)	5.31 (5.85)
CO	1.75 (1.93)	0.98 (1.08)	2.73 (3.01)
HCl	1.73 (1.91)	1.77 (1.95)	3.50 (3.86)
N_2	0.68 (0.75)	5.77 (6.36)	6.45 (7.11)
H_2O	0.92 (1.02)	1.93 (2.13)	2.85 (3.15)
H_2	0.16 (0.17)	0.00 (0.00)	0.16 (0.17)
CO_2	0.34 (0.37)	1.47 (1.62)	1.81 (1.99)
Other	0.00 (0.00)	0.16 (0.18)	0.16 (0.18)

Source: Dailey, 1993 as referenced in U.S. Army Space and Strategic Defense Command, 1994d and U.S. Army Space and Missile Defense Command, 2003.

Exhibit 4-12. Emission Products from Launches of Representative Targets and Lasers in kilograms (pounds)

Emission Product	Target	Laser	Total	Total metric tons (tons)
Al_2O_3	2,300 (5,060)	-	2,300 (5,060)	2.30 (2.54)
CO	1,747 (3,846)	-	1,747 (3,846)	1.75 (1.93)
HCl	1,733 (3,815)	-	1,733 (3,815)	1.73 (1.91)
N_2	680 (1,497)	108 (238)	788 (1735)	0.79 (0.87)
H_2O	924 (2,033)	540 (1,190)	1464 (3223)	1.46 (1.61)
H_2	156 (344)	23 (51)	179 (395)	0.18 (0.20)
CO_2	336 (739)	396 (873)	732 (1612)	0.73 (0.81)
Oxygen	-	270 (595)	270 (595)	0.27 (0.30)
Cl	-	36 (79)	36 (79)	0.04 (0.04)
Ammonia	-	81 (179)	81 (179)	0.08 (0.09)
Iodine	-	13 (29)	13 (29)	0.01 (0.01)

Source: U.S. Army Space and Strategic Defense Command, 1993c; Dailey, 1993 as referenced in U.S. Army Space and Strategic Defense Command, 1994d and U.S. Department of the Air Force, 1997b

SIFT Scenario 2- Multiple Weapons with Multiple Intercepts

In addition to the impacts presented under SIFT Scenario 1, the emissions from launching any two targets (liquid- or solid-propellant) from the same location at the same time would not be expected to result in significant impacts to air quality, provided that such an activity is within the operating parameters of the launch facility or range. The launch or activation of multiple weapons and use of additional support equipment would result in a localized increase in emissions. The concentration of the localized emissions and the subsequent severity of the impact would vary based on the number of launches or activations and support equipment, the proximity (both geographically and in time) of each launch or activation and operation of support equipment, and the specific location of such activities within a biome. The combined impacts of all the emissions associated with SIFT Scenario 2 (emissions from support equipment, launches, laser activations, and debris from intercepts) might result in significant impacts to air quality. Site-specific environmental analysis would be completed to evaluate potentially significant impacts.

4.1.2.2 Airspace

Integrated GTs

EMR and other radio frequency transmissions associated with radar sensors and C2BMC equipment activated during GTs could potentially impact airspace operations by interfering with communication and navigation equipment. Coordination with the appropriate FAA ARTCC, relevant military installations, and relevant foreign countries with jurisdiction over affected airspace would minimize the potential for impact from these tests.

In addition, laser sensors have the potential to cause eye damage to aircraft pilots. All laser sensors would be operated according to appropriate range safety regulations. An increase in the number of laser sensors activated during GTs would not be expected to significantly impact airspace.

SIFT Scenario 1 - Single Weapon with Intercept

In addition to the impacts presented under GTs, the impacts associated with airspace from SIFT Scenario 1 would include the additional restricted airspace associated with launches and the activation of lasers. Launches of targets and the activation or launch of a weapon, and impact of the target and interceptor would occur in designated areas of cleared airspace. Close coordination with the appropriate FAA ARTCC, relevant military installations, and foreign countries with jurisdiction for airspace management would minimize the potential for any adverse impacts on airspace use and scheduling. In addition, before conducting an operation that is potentially hazardous to non-participating aircraft, NOTAMs would be issued.

Retrieval of debris on land would occur within the boundaries of the designated impact area; therefore, debris retrieval would have no impact on navigable airspace or airborne activities outside the restricted airspace complex. It is not anticipated that debris falling into the BOA would be retrieved.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

In addition to the impacts presented under SIFT Scenario 1, the additional impacts to airspace under SIFT Scenario 2 would result from a larger portion of cleared airspace required to support the specific SIFT, the increased duration of the test, the additional debris areas associated with two targets and multiple intercept attempts, and increased operation of support equipment, which could result in an increase in the disruption of commercial and civilian air travel and operations. Close coordination with the appropriate FAA ARTCC, military installations, and relevant foreign countries with jurisdiction over affected airspace would reduce the potential impacts to airspace. Upon completion of such coordination for each test, there would be no significant impacts to airspace.

4.1.2.3 Biological Resources

Integrated GTs

Impacts to biological resources resulting from GTs would include EMR emissions from radar sensors and laser beams from laser sensors. The size, motion, and orientation of the beams would limit the beam exposure time on biological resources. An increase in the number of radar sensors operating within a biome would increase the risks to biological resources, but the impacts would be insignificant.

SIFT Scenario 1 – Single Weapon with Intercept

In addition to the impacts presented under GTs, the impacts from SIFT Scenario 1 would include the emissions associated with activation of lasers, including CO_2, ammonia, and chlorine. Such impacts are considered to be minor as the laser would be operated for a few seconds per launch, and would not emit large quantities of gases. Potential impacts from launches include emissions, deposition of hazardous materials, debris associated with intercepts, and noise associated with launch and flight. Impacts to biological resources associated with SIFT Scenario 1 activities would result primarily from the noise associated with launch and intercept. Sonic booms may create startle responses in some animals. Debris from the intercept could directly hit an animal. Coordination and consultation with appropriate regulatory agencies, as well as adherence to appropriate and relevant international treaties, would be required to address any potentially significant impacts on biological resources. Impacts to biological resources would depend on the

biome in which the launch and intercept took place. The potential for and extent of impact would need to be examined in site-specific environmental analysis.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

In addition to the impacts presented under SIFT Scenario 1, the environmental impacts to biological resources under SIFT Scenario 2 are related to the biome and the threatened and endangered species, the unique or sensitive environments, and the migratory, breeding, and feeding activities that occur in the biome, which would be affected by such activities. Site-specific environmental analysis would be completed to evaluate potentially significant impacts.

4.1.2.4 Geology and Soils

Integrated GTs

Impacts to geology and soils as a result of GTs would be limited to fuel spills associated with generators. Appropriate control, handling, and clean up procedures would be in place for any hazardous material spills or leaks. An increase in the number of sensors or C2BMC systems tested within a biome would not significantly increase the impacts to geology and soils.

SIFT Scenario 1- Single Weapon with Intercept

In addition to the impacts presented under GTs, the impacts from SIFT Scenario 1 would include increased soil acidity from the emission of small amounts of chlorine if the laser is activated in a humid biome. Similarly, HCl emitted primarily from launch of solid propellant boosters could be deposited on the soil in the form of acid rain and result in increased soil acidity.

Impacts to geology and soils also may result from the emissions and subsequent deposition of PM and any simulant used in the target. A target launch and the activation or launch of a weapon would not result in a significant impact to geology and soils.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

The activities performed under SIFT Scenario 2 would not impact geology. In addition to the impacts presented under SIFT Scenario 1, the environmental impacts to soils under SIFT Scenario 2 would be related to the biome, the characteristics and condition of the soil, and the type and amount of material that would be deposited on the soil during a test event. Site-specific environmental analysis would be completed to evaluate potentially significant impacts.

4.1.2.5 Hazardous Materials and Hazardous Waste

Integrated GTs

GTs would involve an increase in the volume of hazardous materials and hazardous wastes used and generated by the testing of sensors and C2BMC systems. However, hazardous materials and hazardous waste would be handled in accordance with all applicable regulations, and each test location would have an SPCC plan in place to handle any spills or leaks of hazardous materials. An increase in the use of sensors and communication systems in a biome would not result in significant impacts from hazardous materials and hazardous waste.

SIFT Scenario 1 – Single Weapon with Intercept

SIFT Scenario 1 would potentially increase the impacts from hazardous materials and hazardous waste. The impacts from laser activation would include the production of spent laser chemicals, which would be neutralized and treated as waste. Potential impacts from launches include fueling procedures (if applicable) and debris disposal. Appropriate waste management and disposal procedures would be in place to safely manage these substances in accordance with applicable regulations.

For a target launch and the activation of a laser or launch of an interceptor, impacts from hazardous materials and hazardous waste would not result in a significant impact. Applicable regulations and procedures would be followed and would prevent impacts from management and disposal of hazardous materials or hazardous waste. If appropriate, debris from launches would be handled in accordance with approved disposal requirements.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

The activities under SIFT Scenario 2 would use more hazardous materials and would generate more hazardous waste than those under SIFT Scenario 1. The increased use and generation of hazardous materials and hazardous waste would not result in a significant impact. Hazardous materials and hazardous waste including debris (if appropriate) would be handled in accordance with approved disposal requirements.

4.1.2.6 Health and Safety

Integrated GTs

Operation of multiple sensors and C2BMC systems during GTs would increase potential risks to health and safety. All health and safety procedures would be followed in the operation of the sensors and C2BMC systems. Appropriate safety exclusion zones,

personnel exclusion zones, and EMR hazard zones would be established prior to testing. All participating personnel would be trained and certified in the risks associated with testing and operation of sensors and C2BMC systems. As a result, the increase in risks to health and safety would not be considered significant.

SIFT Scenario 1 – Single Weapon with Intercept

The potential impacts associated with SIFT Scenario 1 would increase the exposure to health and safety risks from those found in the GTs. Impacts would include potential impacts from laser operation including handling laser chemicals and potential contact with the laser beam. Potential impacts to health and safety from launches include exposure to explosives, contact with launch debris, and exposure to noise produced during launch.

Impacts to health and safety from activities associated with SIFT Scenario 1 would depend on the biome in which launches and intercept took place. Because launches would take place on facilities or at locations with restricted access, members of the public would not be exposed to these hazards. Operating procedures would be developed to protect personnel, reducing any potential impacts to less than significant levels. Individuals exposed to health and safety risks would be DoD or DoD contractor personnel, other participants in the test, and other support, security, or observer personnel. All personnel exposed to elevated health and safety risks would be trained and certified for such risks, while the remaining test personnel would be briefed on the health and safety risks in accordance with appropriate and relevant regulations and standard operating procedures. The establishment of restricted impact areas and adherence to applicable regulations and standard operating procedures would reduce impacts from debris to less than significant levels.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

The activities associated with SIFT Scenario 2 would result in an increased exposure to health and safety risks in comparison to those associated with SIFT Scenario 1. The increased exposure to health and safety risks associated with SIFT Scenario 2 would not be expected to result in a significant impact.

4.1.2.7 Noise

Integrated GTs

Impacts from noise as a result of GTs would be limited to noise associated with the operation of generators required to activate sensors and C2BMC. Noise impacts from generators would be dependent on the intensity, the duration, and the proximity of the noise to sensitive receptors. The generators would be operated during tests, and sea- and

air-based systems typically would not be operated in proximity to sensitive receptors. Site-specific environmental analysis would be completed to evaluate potentially significant impacts. However, in general, the increase in noise from multiple generator use within a biome would not be significant.

SIFT Scenario 1 – Single Weapon with Intercept

Potential impacts from noise associated with SIFT Scenario 1 would be greater than those associated with GTs. For a target launch and the activation of a laser or launch of an interceptor, up to two sonic booms would be generated. The sonic booms could each produce overpressures as high as 8 to 16 pounds per square foot; however, these would be of short duration, lasting up to several milliseconds. Noise produced above 12,192 meters (40,000 feet) would not affect ground level noise. In addition, launches would occur at locations where members of the public would not be exposed to launch noise in excess of OSHA regulations. Personnel associated with launch would either be removed from the launch location or would use hearing protection to reduce exposure to less than significant levels. Impacts would be dependent on the biome in which launches and intercept took place. However, in general, noise associated with SIFT Scenario 1 would not be significant.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

The activities under SIFT Scenario 2 would result in increased noise levels when compared to SIFT Scenario 1. Activities under SIFT Scenario 2 will be evaluated for noise on a case-by-case basis.

4.1.2.8 Transportation

Integrated GTs

Impacts to transportation as a result of GTs would be limited to those associated with radar sensors. Air and marine transportation could be impacted by EMR emissions. Impacts to air transportation are described in Airspace. For marine transportation, NOTMARs would be issued in advance of the testing event to allow vessels to plan alternate routes to avoid the EMR hazard areas. The activation of multiple sensors in a biome would not significantly impact transportation.

SIFT Scenario 1 – Single Weapon with Intercept

In addition to the impacts presented under GTs, potential impacts to transportation from SIFT Scenario 1 would include temporary road closures around launch sites, expected flight trajectories, and debris impact zones. Debris recovery on land would require a relatively small number of vehicles. For SIFT Scenario 1 activities, areas around the

launch sites, the expected flight trajectories, and debris impact zone would be affected. However, closures of roads, airspace, and marine areas would be of short duration and would be considered routine occurrences for launch sites. Issuance of NOTAMs and NOTMARs would allow vehicles to clear the affected areas. All transportation of the components and support assets would be completed in accordance with the appropriate and relevant national and international standards and requirements. Therefore, no significant transportation impacts would be expected.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

The increase in transportation requirements or any increases in the frequency, duration, or number of transport route closures that would be required under SIFT Scenario 2 would not result in a significant transportation impact. All closures would be coordinated through the appropriate authorities.

4.1.2.9 Water Resources

Integrated GTs

GTs would involve an increase in risk for hazardous materials and hazardous waste spills and an increase in demand for potable water. Spills and leaks of hazardous materials and hazardous waste would be handled according to appropriate regulations and to the spill plans at each test site. Potable water supplies could be impacted, especially in areas with limited water supplies and infrastructure. The increase in personnel in these areas associated with GTs could exceed the capacity of the available potable water supply infrastructure. Site-specific environmental analysis would be completed to evaluate potentially significant impacts. However, in general impacts to water resources would not be significant.

SIFT Scenario 1 – Single Weapon with Intercept

Impacts to water resources from SIFT Scenario 1 would add to those associated with GTs. Impacts would include the generation of HCl from laser activation and launches of some boosters. For a target launch and the activation of a laser or launch of an interceptor occurring in the same biome, impacts to water resources would be dependent on the biome in which the launches and intercept took place. An early flight termination could result in propellant and debris from the target and interceptor being deposited in water bodies. Specific impacts on water resources are related to the biome and the unique or sensitive environments (wetlands, marine sanctuaries, essential fish habitat) that occur in the biome, which would be affected by such activities. Coordination and consultation with appropriate regulatory agencies would be required to address any potentially significant impacts on water resources. Impacts to water resources from laser

activation and launches occurring in different biomes would not have additive impacts of activities occurring within the same biome.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

In addition to the impacts presented under SIFT Scenario 1, the environmental impacts on water resources under SIFT Scenario 2 would result from increased pollutant emissions and subsequent deposition associated with the launches and successful intercepts or flight terminations. Site-specific environmental analysis would be completed to evaluate potentially significant impacts.

4.1.2.10 Orbital Debris

Integrated GTs

The amount of orbital debris would not be impacted by GTs.

SIFT Scenario 1 – Single Weapon with Intercept

The amount of orbital debris could increase under SIFT Scenario 1, from GMD or boost phase intercepts in the upper atmosphere. Such increases in orbital debris would be temporary, as studies indicate that objects in orbit between 200 and 399 kilometers (123 to 248 miles) reenter the atmosphere within a few months. (Interagency Group [Space], 1989, as referenced in U.S. Department of the Air Force, 1998)

Orbiting objects lose energy through friction with the upper reaches of the atmosphere and various other forces. Over time, the object falls into progressively lower orbits and eventually falls to Earth. As the object's orbital trajectory draws closer to Earth, it speeds up and outpaces objects in higher orbits. Once the object enters the measurable atmosphere, atmospheric drag will slow it down rapidly and cause it either to burn up or deorbit and fall to Earth.

NASA has determined that a significant amount of debris does not survive the severe heating that occurs during reentry. (NASA, 2003a) Components that do survive are most likely to fall into the oceans or other bodies of water or onto sparsely populated regions. During the past 40 years an average of one cataloged piece of debris fell back to Earth each day. No serious injury or significant property damage caused by reentering debris has been confirmed. Although it cannot be determined with certainty how much debris would be produced under SIFT Scenario 1, the fact that the orbital debris would only be on orbit for a limited time, the majority of the orbital debris would burn up upon reentry into the Earth's atmosphere, other orbital debris that falls to Earth daily has not caused injury or significant property damage indicates that orbital debris associated with SIFT Scenario 1 would not pose significant impacts.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

Increases in orbital debris would be greater under SIFT Scenario 2 than SIFT Scenario 1. Under SIFT Scenario 2 additional space-based sensors and C2BMC assets would be used and therefore these platforms could also produce orbital debris. As with SIFT Scenario 1, it may also be possible for debris from boost or midcourse intercepts to become orbital debris until it reenters the Earth's atmosphere. As defined under SIFT Scenario 1, the orbital debris would not pose a significant impact.

4.1.3 Activities at Locations Outside of the Continental U.S.

Some MDA activities may occur outside the continental U.S. (OCONUS), its territories and possessions. Because NEPA and other environmental laws do not generally apply to OCONUS activities, various EOs and DoD directives and instructions have been implemented. Appendix G describes the framework within which the MDA activities must comply regarding these international activities.

Impacts Analysis for MDA OCONUS Activities and Facilities

To conduct an analysis of potential impacts from proposed OCONUS BMDS activities, MDA considered global biomes based on similar ecological characteristics rather than political boundaries. The activities conducted in international locations would have the same emissions and stressors on resource areas as those conducted within the U.S. and its territories, e.g., types and amounts of emissions and noise from booster launches. However, the receiving environment may be very different and international regulatory requirements may have different standards for what constitutes a trigger for significance of impacts. The framework in terms of overseas environmental planning and compliance issues is addressed in Appendix G.

4.1.4 Cumulative Impacts

The proposed action addressed in this PEIS is the development, testing, deployment, and planning for decommissioning for an integrated BMDS to protect the U.S., its allies, and its interests worldwide. Thus this action is worldwide in scope and potential application, and only activities similar in scope have been considered for cumulative impacts. Regional or local past, present, or future activities would be considered for cumulative impact assessment as appropriate, during subsequent site- or action-specific NEPA analyses. Worldwide launch programs for commercial and government programs were determined to be activities of international scope that might reasonably be considered for cumulative impacts in this PEIS. Launches can contribute to cumulative impacts in three specific areas – ozone depletion, global warming, and orbital debris.

The number of BMDS projected launches was estimated at 515[54] during the years 2004 to 2014. Worldwide projected launches, which include 77 U.S. commercial launches (FAA AST, 2003); 99 U.S. government launches (NASA, 2003a; NASA, 2003b; NASA, 2003c); 183 foreign commercial launches (COMSTAC, 2003); and 476 foreign government launches (NASA, 2004; Gunter's Space Page, 2004; Spaceflight Now, 2004a; Spaceflight Now, 2004b), were estimated to total 835 launches during the years 2004 and 2014.

Exhibit 4-13 summarizes both BMDS and other worldwide launch emission loads to the stratosphere, based on the projected number of launches identified above. Note that the load to the troposphere would be the same as the load to the stratosphere because the residence time is assumed to be the same and the propellant types used are assumed to be the same (see Appendix I for assumptions used to estimate launch emissions loads).

Exhibit 4-13. Summary of Estimated Emission Loads to the Stratosphere from Launches (2004-2014) in metric tons (tons)*

	HCl	Al_2O_3	CO_2	H_2O	N_2	Cl	NO_X	CO
BMDS Projected Launches	1,344 (1,481)	2,432 (2,680)	3,118 (3,436)	1,810 (1,994)	0 (0)	18 (20)	1,821 (2,006)	0 (0)
Worldwide Projected Launches	6,526 (7,192)	11,777 (12,979)	57,287 (63,130)	50,298 (55,429)	0 (0)	87 (96)	94,933 (104,616)	0 (0)
Total Projected Launches	7,870 (8,673)	14,210 (15,659)	60,404 (66,566)	52,108 (57,413)	0 (0)	105 (116)	96,754 (106,623)	0 (0)

*Calculations subject to rounding; see Appendix I for additional information on launch emission load calculations and related assumptions

Global Warming

Potential launch emissions that could affect global warming include CO and CO_2. Unlike CO_2, CO is not a greenhouse gas; however, it can contribute indirectly to the greenhouse gas effect and is therefore included in this analysis. The cumulative impact on global warming from launches would be insignificant compared to other industrial sources (e.g., energy generation using fossil fuel) and activities (e.g., deforestation and land clearing). Estimated BMDS launch emissions load of CO and CO_2 to the troposphere and stratosphere would account for only five percent of the emissions load from launches worldwide. However, even when accounting for both BMDS launches and other launches worldwide, the CO and CO_2 load would be extremely small compared to

[54] Projected number of launches based on MDA estimates.

emissions loads from other industrial sources just in the U.S. As Exhibit 4-14 indicates, the amount of CO and CO_2 emissions load from all launches over the ten-year period under consideration would account for 3.5 x 10^{-4} percent of CO and CO_2 emissions load from U.S. industrial sources in one year.

Exhibit 4-14. Comparison of Emission Loads of CO and CO_2 to both the Troposphere and Stratosphere

Emission Sources	CO and CO_2 Emissions in metric tons (tons)*
BMDS Projected Launches from 2004-2014	6,235 (6,871)
Worldwide Projected Launches from 2004-2014	114,573 (126,260)
Other Industrial Sources in the U.S.**	34 billion (37.6 billion) for one year 136.3 billion (150.2 billion) for four years

* Calculations subject to rounding
** Source: EPA, 2003d

Ozone Depletion

Ozone depletion is a major concern, as the stratospheric ozone layer protects the Earth from adverse levels of ultraviolet radiation. Chlorine is a chemical of primary concern with respect to ozone depletion. Launches are one of the human-made sources of chlorine in the stratosphere. The cumulative impact on stratospheric ozone depletion from launches would be far below and indistinguishable from the effects caused by other natural and man-made causes. Projected BMDS launches would include boosters considerably smaller than those used on the Space Shuttle; therefore, the air quality impacts from the Space Shuttle provide a conservative upper bound for comparison.

As Exhibit 4-15 indicates, the emission loads of chlorine (as HCl and free Cl) from both BMDS and other launches worldwide as projected from 2004-2014 would account for only 0.5 percent of the industrial Cl load from the U.S. over the 10-year period. The majority of the chlorine load from launches is as HCl, which does not readily break down into the ozone-depleting substance Cl. Also, the HCl in the troposphere is usually quickly removed by water in the atmosphere. The emissions load of chlorine from launch activities would also be minimal in comparison to the 362,874 metric tons (400,000 tons) of inorganic chlorine created annually by photolysis of historical reservoirs of CFCs. (DOT, 2001b)

Exhibit 4-15. Comparison of Emission Loads of Chlorine (HCl and Free Cl) in both the Troposphere and Stratosphere

Emission Source	Cl Emissions in metric tons (tons)*
Projected BMDS Launches 2004-2014	2,724 (3,002)
Projected Worldwide Launches 2004-2014	13,226 (14,580)
Other Industrial Sources in the U.S 2004-2014**	2,993,694 (3,000,000)

* Calculations subject to rounding
**Source: Adapted from DOT, 2001b

Almost all of the studies to date on ozone depletion from launches are based upon homogenous gas phase chemistry, which does not address the effects from particulates and aerosols released during ascent. There are no commonly accepted models that accurately predict the effects from particulates and aerosols on ozone depletion caused by launches. Future analysis of launches using heterogeneous chemistry could significantly alter the understanding of cumulative impacts of launch emissions on stratospheric ozone depletion. There is some evidence that particulates may play a larger role in ozone-depletion reactions than has currently been demonstrated. If this were the case, assuming only homogeneous gas phase chemistry (i.e., no effects from particulates or aerosols), the amount of ozone depletion actually occurring as a result of emissions from launches would be underestimated.

Orbital Debris

Orbital debris would be produced by space-based BMDS sensors and space-based C2BMC components and could be produced by midcourse and boost phase intercepts with sufficient energy. The effects of orbital debris on other spacecraft would depend on the altitude, orbit, velocity, angle of impact, and mass of the debris. Debris less than 0.01 centimeter (0.004 inch) in diameter can cause surface pitting and erosion. Over a long period of time, the cumulative effect of individual particles colliding with a satellite might become significant because the number of particles in this size range is very large in LEO. Long-term exposure of payloads to such particles is likely to cause erosion of exterior surfaces and chemical contamination, and may degrade operations of vulnerable components such as optical windows and solar panels. Debris between 0.01 and 1 centimeter (0.004 and 0.4 inch) in diameter could cause significant impact damage that could be serious, depending on system vulnerability and defensive design provisions. Objects larger than 1 centimeter (0.4 inch) in diameter can produce catastrophic damage. Although it is currently practical to shield against debris particles up to one centimeter (0.4 inch) in diameter (a mass of one gram [0.05 ounce]), for larger debris, current shielding concepts become impractical. (Office of Science and Technology Policy, 1995, as referenced in U.S. Department of the Air Force, 1998)

Astronauts or cosmonauts engaging in extra-vehicular activities could be vulnerable to the impact of small debris. On average, debris one millimeter (0. 04 inch) in diameter is capable of perforating current U.S. space suits. (Cour-Palais, 1991, as referenced in Commission on Engineering and Technical Systems, 1995)

Solid rocket motors eject Al_2O_3 dust (typically less than 0.01 centimeter [0.004 inch] in diameter) into the orbital environment, and may release larger chunks of unburned solid propellant or slag. However, solid rocket motor particles typically either decay very rapidly, probably within a few perigee passages, or are dispersed by solar radiation pressure. Thus, the operational threat of solid rocket motor dust is probably limited to brief periods of time related to specific mission events. (Office of Science and Technology Policy, 1995, as referenced in U.S. Department of the Air Force, 1998)

Orbital debris generated by launch vehicles contributes to the larger problem of pollution in space that includes radio-frequency interference and interference with scientific observations in all parts of the spectrum. For example, emissions at radio frequencies often interfere with radio astronomy observations. (Office of Technology Assessment, 1990, as referenced in U.S. Department of the Air Force, 1998) Not only can orbital debris interfere with the performance of scientific experiments, but also it can even accidentally destroy them. (Scheraga, 1986, as referenced in U.S. Department of the Air Force, 1998)

Orbiting objects lose energy through friction with the upper reaches of the atmosphere and various other forces. Over time, the object falls into progressively lower orbits and eventually falls to Earth. As the object's orbital trajectory draws closer to Earth, it speeds up and outpaces objects in higher orbits. Once the object enters the measurable atmosphere, atmospheric drag will slow it down rapidly and cause it either to burn up or deorbit and fall to Earth.

NASA has determined that a significant amount of debris does not survive the severe heating that occurs during reentry. (NASA Orbital Debris Program, 2003) Components that do survive are most likely to fall into the oceans or other bodies of water or onto sparsely populated regions like the Canadian Tundra, the Australian Outback, or Siberia in the Russian Federation. During the past 40 years an average of one cataloged piece of debris fell back to Earth each day. No serious injury or significant property damage caused by reentering debris has been confirmed. Although it cannot be determined with certainty how much debris would be produced from BMDS activities, or how much debris is produced by worldwide launches annually, the fact that orbital debris reenters on a daily basis and this debris has not caused injury or significant property damage indicates that orbital debris produced by BMDS space-based sensors would not pose significant impacts. Therefore the cumulative impacts of orbital debris for Alternative 1 are expected to be less than significant.

4.2 Alternative 2 – Implement BMDS Using Land-, Sea-, Air-, and Space-Based Weapons Platforms

Alternative 2 includes the use of weapons from land-, sea-, air-, and space-based platforms. The impacts associated with the use of weapons from land, sea, and air platforms would be the same as discussed for Alternative 1. Therefore, the analysis for this alternative will focus only on the additional impacts of using weapons from space-based platforms. Although MDA has historically conducted research and development efforts on space-based lasers, these efforts have been put on hold as kinetic energy missile technology, which is more promising in the short term, is being pursued. Therefore, this PEIS only addresses space-based interceptor technology and any future application of lasers from a space platform would be addressed as required.

4.2.1 Impacts Analysis

If Alternative 2 were selected, additional environmental analysis could be needed as the technologies intended to be used become more defined and robust. Because the impacts associated with the use of interceptors from space-based platforms are not environment specific, the impacts analysis for this alternative will not discuss specific environments.

The life cycle activities for space-based interceptors would be as described in Section 4.1 and in Exhibit 4-3.

For purposes of impacts analysis for space-based interceptors it was assumed that all manufacturing activities impacts would be the same as those discussed for Alternative 1. Therefore, they are not discussed for Alternative 2.

Space-based interceptors would be launched on launch vehicles and maintained from platforms similar to other satellites used for DoD and commercial purposes in a prescribed orbit around the Earth. The launch vehicles used to insert the weapon platforms into the proper orbit would likely be existing launch vehicles; and therefore, the impacts of the launch would be as described for Support Assets.

The impacts associated with the use of space-based interceptors and debris and deorbiting are unique to space and are discussed in some detail in this section. The NEPA and EO 12114, which require review of the environmental impact of certain Federal actions, do not apply to impacts in space. However, this PEIS considers the impacts that space-based objects, including orbital debris, might have on the terrestrial environment. Therefore, this analysis will focus on the impact to Earth of the launch of interceptors and the reentry of orbital debris.

Interceptors

Interceptors may be used from space-based platforms. Although preliminary design and development has been considered for a space-based interceptor, in the future MDA may develop and test other space-based interceptor designs.

Space-based interceptors would most likely be placed in LEO via existing launch vehicles. The booster used on the space-based interceptor would be either a pre-fueled liquid propellant booster or a solid propellant booster, with properties similar to those interceptors described in Alternative 1. It is unlikely that a non-pre-fueled liquid propellant would be used on a space platform. The interceptor and platform would likely be composed of aluminum, magnesium, carbon resin composites, titanium, and limited quantities of beryllium.

Space-based interceptors would be capable of providing defense against threat missiles in all flight phases. Because of this, the launch scenario may direct the interceptor towards Earth along a trajectory to intercept a threat missile. In planning test activities, the MDA would select launch scenarios that would result in both the interceptor and the debris impacting in designated areas either in the ocean or on cleared land-based ranges. The space-based interceptors may also be equipped with an FTS that, in the event of a launch mishap, would be activated to destroy the interceptor. The resulting debris from the interceptor would be the same as that produced during a successful intercept and would be as discussed for other debris.

Orbital Debris

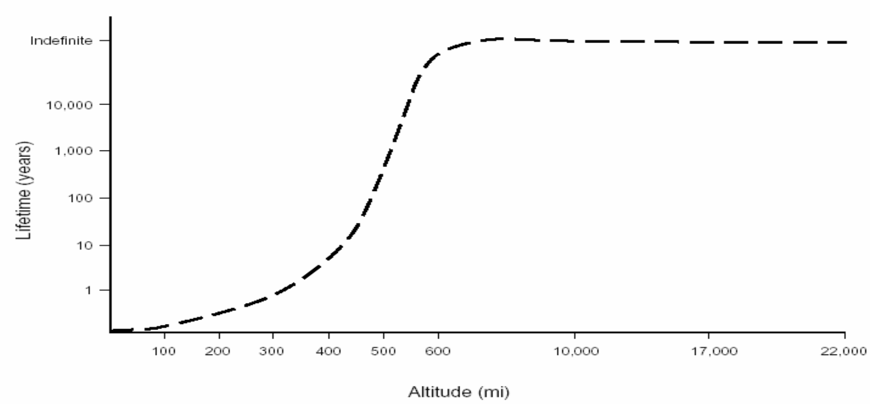
Orbital debris presents the most significant deviation from the impacts described for Alternative 1. Orbital debris generally refers to material that is on orbit as the result of space initiatives, but is no longer serving any function. Orbital debris can return to Earth via controlled or planned deorbiting or via uncontrolled deorbiting. Using interceptors from a space-based platform would create orbital debris, from successfully intercepting a threat missile and causing it to break up or from the break up of an unsuccessful interceptor or the space platform.

Space-based weapons platforms would contribute to orbital debris while in orbit and upon deorbiting, potentially hitting other satellites in their paths. The U.S. Air Force Space Command, located inside Cheyenne Mountain AFS, Colorado, tracks objects larger than 10 centimeters (4 inches) in diameter orbiting Earth. Space surveillance conducted by U.S. Space Command includes reentry assessment to predict when and where an object would reenter the Earth’s atmosphere. U.S. Space Command does not, however, make surface impact predictions. NASA estimates that there are over 9,000 objects larger than 10 centimeters (4 inches) in diameter in space. The estimated population of particles between 1 and 10 centimeters (0.4 and 4 inches) in diameter is

greater than 100,000, and the number of smaller particles probably exceeds tens of millions. (NASA, 2001, as referenced in U.S. Department of the Air Force, 1998)

The addition of orbital materials from the operation of space-based weapons would contribute to the accumulation of orbital debris in LEO. Unless reboosted, satellites in orbits at altitudes of 200 to 399 kilometers (124 to 248 miles) reenter the atmosphere within a few months. At orbital altitudes of 399 to 900 kilometers (248 to 559 miles), orbital lifetimes can exceed a year or more depending on the mass and area of the satellite. Above 900-kilometer (559-mile) altitudes, orbital lifetimes can be 500 years or more. (Interagency Group [Space], 1989, as referenced in U.S. Department of the Air Force, 1998) Exhibit 4-16 shows the relationship between altitude and orbital lifetime.

Exhibit 4-16. Relationship between Altitude and Orbital Lifetime



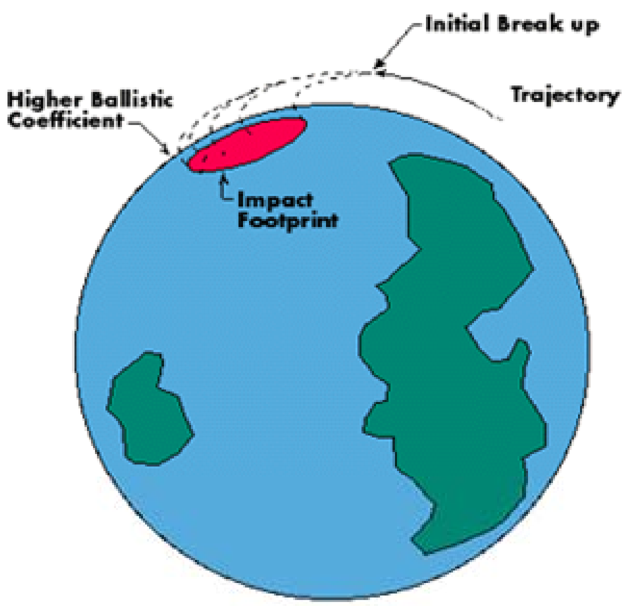
Debris in orbit gradually loses altitude. When orbiting objects enter dense regions of the atmosphere, friction between the object and atmosphere generates heat. This heat can melt or vaporize all or portions of the object resulting in minimal amounts of debris reaching the surface of the Earth. During reentry, the deceleration of the debris creates loads on the structure that can exceed ten times the acceleration of gravity. These loads combine with the high temperature to cause the debris to break apart.

Some debris can survive reentry heating. This occurs if the debris component’s melting temperature is high, or if its shape enables it to lose heat fast enough to keep the temperature below the melting point. (Aerospace Corporation, Center for Orbital Reentry and Debris Studies, 2003) In general, components made of aluminum and other materials with low melting temperatures do not survive reentry, while components made of materials with high melting temperatures, such as stainless steel, titanium, and glass, often do survive. Large pieces with moderate melting temperatures can also survive reentry, radiating heat over their large surface areas. Pieces that survive reentry tend to

be large and in some cases heavy, posing a significant hazard to people and property within the bounds of the object's reentry debris footprint. (Aerospace Corporation, Center for Orbital Reentry and Debris Studies, 2003) When possible, debris impact areas would be carefully selected to include deep ocean areas or designated locations on military ranges. However, the majority of orbital debris burns on reentry and thus does not reach the Earth. It is unlikely that the impact of debris associated with an uncontrolled reentry would pose a significant threat to the environment on Earth.

Debris that survives reentry would impact within debris or impact footprints, i.e., the areas on the land or water surfaces that would contain all of the debris pieces. Debris is more likely to terminate in water than on land because water covers 75 percent of the Earth’s surface. Debris falling into water would produce impacts similar to those described for postlaunch activities in Alternative 1. It is possible to estimate the size of the impact footprint, but very difficult to predict precisely where the footprint would be on the Earth's surface or where specific pieces of debris would land. Exhibit 4-17 shows the various phases of reentry. After initial and subsequent breakups, surviving pieces of the reentering object would hit down in the debris or impact footprint area.

Exhibit 4-17. Typical Satellite Breakup



Source: Aerospace Corporation, Center for Orbital Reentry and Debris Studies, 2003

The size of the debris footprint is determined by estimating the breakup altitude of the orbiting object; then by estimating the mass and aerodynamic properties of surviving debris. Heavy debris would generally travel farther downrange within the debris footprint; lighter material would generally fall near the point of intercept. Footprint lengths can vary from 185 to 2,000 kilometers (115 to 1,243 miles), depending on the characteristics and complexity of the object.

The footprint width is generally determined by the impact of wind on the falling debris objects, with heavy objects less affected than lighter ones. The breakup process also may affect the width of the footprint. For example, if the object should explode during reentry, fragments would be spread out across the footprint. A footprint width of 20 to 40 kilometers (12 to 25 miles) is typical, with the most pronounced effects near the part of the footprint closest to the point of intercept. (Aerospace Corporation, center for Orbital Reentry and Debris Studies, 2003)

Upon termination of the useful life of a space-based weapon, the weapon and its platform would be deorbited in a controlled fashion. The deorbiting process for a space-based interceptor would not be different from deorbiting activities for other DoD or commercial objects on orbit. During the controlled deorbiting process, the interceptor and its platform would either be placed in a disposal orbit, which is normally 300 kilometers (186 miles) above geosynchronous orbit, or lowered through the atmosphere where, after experiencing the friction and heat of reentry, remaining debris would be deposited in a designated area of the ocean. The majority of the platform would be expected to burn upon reentry. The on-board chemicals would also burn, destroying them; therefore, they would not pose a threat to human health or the environment. The impacts associated with debris from deorbiting the weapon and its platform would be similar to the impacts of debris from postlaunch activities described in Alternative 1.

Debris from a successful intercept or a launch mishap resulting in the activation of an FTS would reenter the Earth's atmosphere in an uncontrolled manner. Missions are designed such that in the event of an FTS action by the flight safety officer, debris will reenter and impact either the BOA or on land on cleared ranges. It is also possible that during the planned deorbiting of a platform, the platform would experience a failure or lose communications with the ground controllers in which case the platform may reenter in an uncontrolled manner. In either scenario, the majority of the debris and platform would burn during reentry, resulting in a small amount, if any, inert debris reaching the Earth's surface.

4.2.1.1 Air Quality

Impacts from Launch/Flight

The air emissions associated with launching an interceptor from a space-based platform would be the same as those emitted during launch from any platform discussed in Alternative 1. However, emissions produced in a space environment would not affect the human environment; therefore, there would be no impact to air quality from space-based interceptors.

Impacts from Debris

Upon reentry, the majority of the space-based interceptor and its platform would burn due to the intense friction and heat created during reentry through the Earth's atmosphere. Any on-board hazardous materials would burn and would not pose a threat to human health or the environment. Some small particles and pieces of debris may serve as reaction sites for chemical reactions in the atmosphere; however, due to the infrequency of debris reentry and deorbiting events, the impacts would be insignificant.

4.2.1.2 Airspace

Impacts from Launch/Flight

Although launch of the interceptor would occur in space, the interceptor may be directed towards the Earth during intercepts and could impact the use of airspace in the interceptor's designated path. Any potentially affected airspace would be cleared before launch of the interceptor. Coordination with the appropriate FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impacts to airspace use and scheduling.

Impacts from Debris

For controlled reentries, it would be possible to indicate an area of airspace that would need to remain cleared during reentry events. For uncontrolled reentries, current capabilities and procedures provide a limited ability to predict within a 30-minute, 9,656-kilometer (6,000-mile) window when and where a particular object would reenter the Earth's upper atmosphere. (U.S. Strategic Command, 2002) Given the difficulty in predicting the path of uncontrolled reentering space-based interceptors and their associated platforms, little advance warning could be given to clear airspace. However, most objects break up and vaporize under aerodynamic forces and heating that occur during reentry. Thus potential impacts to airspace are not expected to be significant.

4.2.1.3 Biological Resources

Impacts from Launch/Flight

The launch of interceptors from space-based platforms could result in impacts to biological resources. In the event that an intercept was attempted and was unsuccessful, the trajectory used by the interceptor could cause it to hit the Earth's surface. The trajectory for test events would be carefully selected such that the interceptor would impact in a cleared portion of the ocean or in a cleared military range. Also, space-based interceptors may be equipped with an FTS. In the event of a launch mishap, the FTS

would be activated to destroy the interceptor, which would further reduce impacts to biological resources.

Impacts from Debris

Upon reentry into the atmosphere, the majority of the interceptor and platform would be expected to break up and burn up due to the frictional forces and intense heat created upon reentry. Therefore, any on-board hazardous materials would also be consumed and would not pose a threat to biological resources. The remaining debris would fall to the Earth's surface and likely fall into open ocean waters where impact would be limited to fish and marine animals in the immediate surface waters surrounding the impact point. Fish and marine mammals at lower depths of the ocean would have more time to react to the sound of the impact and would be able to avoid the impact area.

Debris could potentially be scattered over a wide area. Factors affecting an object's path could include variations in the gravitational field of the landmass and ocean areas, solar radiation pressure, and atmospheric drag. Objects reentering may skip off the Earth's atmosphere, similar to a stone skipping across a pond, causing them to impact much further away than originally predicted and unintentionally disturbing wildlife and vegetation. (U.S. Strategic Command, 2002) The impacts of debris affecting biological resources would be similar to the impacts of postlaunch activities as described in Alternative 1.

4.2.1.4 Geology and Soils

Impacts from Launch/Flight

No impacts to geology and soils would be expected from the launch/flight of space-based interceptors.

Impacts from Debris

Because interceptor and station keeping platform propellants would likely be consumed during reentry into the upper atmosphere, debris and deorbiting activities for space-based weapons and their platforms would not be expected to release toxic substances that would impact soils.

The impact of debris from space-based weapons platforms or interceptors reaching the Earth's surface and creating craters or impacting unstable soils would be extremely unlikely, as most debris would not survive reentry. Debris that might survive reentry would likely be very small in size and would not create serious impact force on the surface. Further, when possible, debris impact areas would be carefully selected to include deep ocean areas or designated locations on military ranges, where impacts could

be contained. Because of the infrequency of debris reentry and the expected small size of surviving reentry debris, no significant impacts to geology or soils would be expected.

4.2.1.5 Hazardous Materials and Hazardous Waste

Impacts from Launch/Flight

The launch/flight of interceptors would not produce hazardous waste that would be transported to or disposed on Earth.

Impacts from Debris

Debris that is contaminated with hazardous materials would reenter the Earth's atmosphere and be exposed to high temperatures during reentry. This would likely render the debris inert by the time it reaches the Earth's surface. Debris and deorbited material would not be considered hazardous waste. Therefore, there would be no impact on hazardous waste management from space-based interceptor debris.

4.2.1.6 Health and Safety

Impacts from Launch/Flight

Launch trajectories would be selected such that, in the event of an unsuccessful intercept attempt, the debris from the interceptor launched from a space-based platform would impact in the open ocean area or in a designated area on land. This would minimize the possibility that health and safety of people on the ground would be affected by launch/flight activities. Also, space-based interceptors may be equipped with an FTS. In the event of a launch mishap, the FTS would be activated to destroy the interceptor, which would further reduce impacts to health and safety.

Impacts from Debris

Launch trajectories would be selected such that the debris from a space-based platform would impact in the open ocean area or in a designated area on land. This would minimize the possibility that health and safety of people on the ground would be affected by launch/flight activities. However, in the event of uncontrolled deorbiting, there is potential for the subsequent debris (devoid of any potentially harmful chemicals) to hit and injure humans. However, as mentioned above, humans only inhabit one-eighth of the Earth's surface; therefore, any impacts to health and safety expected from debris and deorbiting material would be minimal. The risk that an individual would be hit and injured by reentering orbital debris is estimated to be less than one in one trillion. As a reference point, the risk that an individual in the U.S. will be struck by lightning is approximately one in 1.4 million. Over the last 40 years, more than 1,400 metric tons

(1,543 tons) of material is estimated to have survived reentry with no reported casualties. (Aerospace Corporation, Center for Orbital Reentry and Debris Studies, 2003) Therefore, the impacts to health and safety expected from debris and deorbiting material would be negligible.

4.2.1.7 Noise

Impacts from Launch/Flight

No impacts from noise would be expected from the launch/flight of space-based interceptors.

4.2.1.8 Transportation

Impacts from Launch/Flight

There would be no impacts to transportation from launch/flight of space-based interceptors.

Impacts from Debris

Any orbital debris falling into the open ocean would most likely not be recovered. Debris recovery on land would be as described for Alternative 1, and would not have an impact on transportation.

4.2.1.9 Water Resources

Impacts from Launch/Flight

There would be no impacts to water resources from launch/flight of space-based interceptors.

Impacts from Debris

Upon reentry through the upper atmosphere, space-based interceptors and components would be subject to extreme heat, destroying residual chemicals or rendering them inert. Therefore, no impacts to water resources would be expected from debris and deorbiting material.

4.2.2 Test Integration

This section assesses the potential for environmental impacts of BMDS System Integration Test activities under Alternative 2.

Description of Tests Analyzed

The System Integration Tests would incorporate land-, sea-, air-, and space-based platforms for weapons, sensors, C2BMC, and support assets. The System Integration Test activities under Alternative 2 would be the same as those presented under Alternative 1.

In addition to the land-, sea-, and air-based interceptors described under Alternative 1, interceptors may be launched from space-based platforms under Alternative 2. All other activities and their associated impacts from System Integration Tests would be the same as those described under Alternative 1. GTs would not involve weapons components; however additional sensor and C2BMC components would be required to control and coordinate the activities of the four weapon platforms (land-, sea-, air-, and space-based) under Alternative 2. The System Integration Tests conducted under SIFT Scenarios 1 and 2 could include launches of interceptors from space-based platforms. Other aspects of these tests would be the same as described under Alternative 1.

Environmental Consequences

Component testing would continue under Alternative 2. These tests would be conducted in addition to the System Integration Tests described under Alternative 1; System Integration Tests conducted under Alternative 2 also could include the use of space-based interceptors. Space-based interceptors would replace a land-, sea-, or air-based weapon launch or activation. Space-based interceptors would be capable of providing defense against threat missiles in all flight phases.

Impacts from activities that are discussed earlier in this PEIS, including System Integration Tests using weapons from land-, air-, and sea-based platforms will not be discussed in this section. The analysis of System Integration Tests under Alternative 2 will focus on those environmental impacts that are unique to the use of space-based interceptors compared to those described for System Integration Test activities under Alternative 1.

The unique activities associated with each type of System Integration Test analyzed in this PEIS under Alternative 2 include

- **Integrated GTs**. The use of additional components to control and coordinate the activities of the four weapon platforms (land-, sea-, air-, and space-based).

- **SIFT Scenario 1 – Single Weapon with Intercept**. The launch of interceptors from space-based platforms with an intercept.

- **SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts**. The launch of multiple interceptors from multiple weapon platforms (land-, sea-, air-, and space-based) at up to two targets with intercepts. Under Alternative 2, the following analysis assumes that the launch of a space-based interceptor would replace a land-, sea-, or air-based weapon launch or activation. The use of support assets or C2BMC during test events is addressed under Alternative 1.

Tests Not Analyzed By Resource Area

- **Integrated GTs**. The use of additional components to control and coordinate the activities of a space-based interceptor would result in a negligible increase in the severity of the impacts across the resource areas presented under Alternative 1; therefore, impacts from GTs will not be considered further in this section.

- **SIFT Scenario 1 – Single Weapon with Intercept**. Under Alternative 2, the launch of the interceptor from a space-based weapon platform instead of a land-, sea-, or air-based platform as described under Alternative 1, would result in a negligible reduction (a beneficial change) in the overall impacts on each resource area. Under Alternative 2 an interceptor launch from a space-based weapon would replace the interceptor launch from a land- or sea-based weapon, which would result in a reduction in ground level emissions. Based on the projected target intercept flight path of a space-based interceptor, Alternative 2 may result in fewer impacts to airspace than Alternative 1. If the flight path were limited to the exoatmosphere, Alternative 2 would have fewer impacts to airspace than Alternative 1; however, if the flight path were directed towards Earth for an endoatmospheric intercept the impacts to airspace would be the same as for Alternative 1. The impacts of the launch of a space-based interceptor would be reduced for air quality, airspace, biological resources, geology and soils, hazardous materials and hazardous waste, health and safety, noise, transportation, and water resources. The impacts of the launch of a space-based interceptor are addressed in Section 4.2.2.10.

  The impacts due to debris from launching an interceptor from a space-based platform are not unique for either SIFT scenario. Launching an interceptor from a space-based platform could allow intercepts to occur at higher levels of the atmosphere than described under Alternative 1, but the impacts due to debris reentry would be the same as those discussed earlier in this PEIS.

Tests Analyzed by Resource Area

- **SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts**. The following sections present the environmental impacts, by resource area, for SIFT Scenario 2. For this programmatic analysis, a qualitative impact assessment for each resource area

was completed because specific System Integration Test parameters have not been developed that would provide quantitative values.

4.2.2.1 Air Quality

Under Alternative 2, there would be fewer impacts on air quality than under Alternative 1. Should an interceptor launch from a space-based weapon replace an interceptor launch from a land- or sea-based weapon, a reduction in ground level emissions would occur. If the activation of an air-based weapon were replaced, then a reduction in emissions would occur in the upper atmosphere (12,192 meters [40,000 feet]). The intercept would occur in the upper levels of the atmosphere, and would potentially occur in the exoatmosphere, where the majority of debris would burn upon reentry into the Earth's atmosphere.

4.2.2.2 Airspace

Under Alternative 2, there would be fewer impacts on airspace than under Alternative 1. Launch of an interceptor from space could result in a reduction in potential interference with airspace. Based on the projected target intercept flight path of a space-based interceptor, Alternative 2 may result in fewer impacts to airspace than Alternative 1. If the flight path is limited to the exoatmosphere, Alternative 2 would have fewer impacts to airspace than Alternative 1; however, if the flight path is directed towards Earth for an endoatmospheric intercept the impacts to airspace would be the same as for Alternative 1. Whether the intercept of a space-based weapon occurs in the endoatmosphere or exoatmosphere, the debris associated with an intercept of a space-based weapon would have the same impact on airspace as presented under Alternative 1. For exoatmospheric intercepts, the majority of the debris would burn upon reentry into the Earth's atmosphere; however, airspace would have to be cleared to allow for any debris from such an intercept to pass through the atmosphere to the surface of the Earth.

4.2.2.3 Biological Resources

Under Alternative 2, there would be fewer impacts on biological resources than under Alternative 1. Launch noise produced from a space-based interceptor would not reach the Earth. Therefore, tests under SIFT Scenario 2 would result in a reduction in noise and pollutant emissions associated with a launch or laser activation which could adversely affect biological resources. Specific impacts on biological resources would be related to threatened and endangered species, unique or sensitive environments, and migratory, breeding, and feeding activities that occur in an environment affected by such activities.

Coordination and consultation with appropriate regulatory agencies, as well as adherence to appropriate and relevant regulations would be required to address any potentially significant impacts on biological resources. Site-specific environmental analysis would be completed to evaluate such impacts.

4.2.2.4 Geology and Soils

The activities performed under Alternative 2 would not impact geology. Under Alternative 2, there would be fewer impacts on soil than under Alternative 1. If an interceptor launch from a space-based weapon would replace an interceptor launch from a land-based weapon there would be a reduction in ground level emissions; however, if launch of a sea- or air-based interceptor were replaced, there would be no change in the impact on soils.

4.2.2.5 Hazardous Materials and Hazardous Waste

Under Alternative 2, there would be fewer hazardous material and waste impacts than under Alternative 1. Fewer hazardous materials and hazardous waste would need to be disposed on Earth under Alternative 2. Such reductions would occur through the reduction of a launch or activation of a weapon from the human environment and the associated use of hazardous materials, and generation of hazardous waste. Because no impacts were identified under Alternative 1 from the increased use and generation of hazardous materials and hazardous waste, no significant impacts would be associated with Alternative 2.

4.2.2.6 Health and Safety

Under Alternative 2, there would be fewer health and safety impacts than under Alternative 1. Launching an interceptor from space rather than from land, air, or sea would result in a reduction in the number of individuals that would be exposed to health and safety risks associated with launch activities. Because no significant impacts were identified under Alternative 1 from the increased use and generation of hazardous materials and hazardous waste, no significant impacts would be expected from Alternative 2.

4.2.2.7 Noise

Under Alternative 2, there would be fewer noise impacts than under Alternative 1. Noise produced from the launch of interceptors from space-based platforms would not be audible on Earth. Because no significant impacts were identified under Alternative 1 from increased noise, no significant impacts would be expected from Alternative 2.

4.2.2.8 Transportation

The transportation impacts under Alternative 2 would be the same as the impacts under Alternative 1.

4.2.2.9 Water Resources

Under Alternative 2, there would be fewer impacts on water quality than under Alternative 1. An interceptor launch from a space-based weapon would replace an interceptor launch from a land-, sea-, or air-based weapon, which would result in a potential reduction in the debris and simulants that would reach a water resource based on the altitude where an intercept or flight termination would occur. Specific impacts on water resources are related to the unique or sensitive environments (wetlands, marine sanctuaries, essential fish habitat) that occur in the biome, which would be affected by such activities. Coordination and consultation with appropriate regulatory agencies, as well as adherence to appropriate and relevant regulations would be required to address any potentially significant impacts on water resources. Site-specific environmental analysis would be completed to evaluate potentially significant impacts.

4.2.2.10 Orbital Debris

- **SIFT Scenario 1 – Single Weapon with Intercep**t. Increases in orbital debris would be greater under Alternative 2 than under Alternative 1. Under Alternative 2 a higher proportion of the SIFT Scenario 1 tests would occur in the upper atmosphere because of testing associated with the space-based weapon. As defined under Alternative 1, the orbital debris would not pose a significant impact.

- **SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts**. Increases in orbital debris would be greater under SIFT Scenario 2 than SIFT Scenario 1. Under SIFT Scenario 2 space-based interceptors, may be launched at a target in the upper atmosphere. As defined under Alternative 1, the orbital debris would not pose a significant impact.

4.2.3 Cumulative Impacts

As described for cumulative impacts from Alternative 1, worldwide launch programs for commercial, civil, and military programs were determined to be actions of international scope that could be appropriately considered for cumulative impacts in this PEIS. The impacts of worldwide launch programs were considered in the discussion of cumulative impacts for Alternative 1.

Alternative 2 includes placing weapons on all platforms considered for Alternative 1 (land, air, and sea) and placing weapons in space. The air emissions associated with launching interceptors from a space-based platform would be the same as those emitted during launch from any platform discussed in Alternative 1. However, emissions produced in a space environment would not affect the human environment; therefore, the cumulative impacts analysis for Alternative 2 does not address the additive impacts of emissions produced by launches from a space-based platform. Placing weapons in space

involves adding additional structures to space for extended periods of time; therefore, it is appropriate to include in this cumulative impacts analysis other programs that are international in scope which place structures in space for extended periods of time. The International Space Station (ISS) was determined to be an action that is international in scope and has a purpose of placing structures in space for extended periods of time. Therefore the cumulative impacts analysis for Alternative 2 encompasses the discussion of worldwide launch programs as discussed for Alternative 1 and includes a discussion of the impacts of the proposed BMDS in conjunction with the ISS.

The ISS is a collaborative project including contributions from 27 countries worldwide. As originally designed, the ISS would have a mass of about 471,736 kilograms (1,040,000 pounds) and would measure 109 meters (356 feet) across and 88 meters (290 feet) long, with almost an acre of solar panels. (ISS, 1999) The first piece of the ISS was placed into orbit on November 20, 1998; the ISS is still under construction and therefore the current orbiting structure does not meet the dimensions described above. However, the ISS the largest single human-made structure currently orbiting in space.

The ISS maintains an orbit around the Earth. The ISS and other man-made orbiting objects can be adversely affected by orbital debris. Orbital debris is produced during orbital launches and would be produced during some proposed BMDS test events and activities including those used to place space-based weapons on orbit. If the orbital debris produced during BMDS activities was located in orbits on the same plane or higher than the ISS the potential would exist for orbital debris to impact the ISS. The extent of the impact of orbital debris on structures depends on the size of the debris and the velocity at which it is traveling.

Debris as small as a fleck of paint approximately 0.02 centimeter (0.008 inches) in diameter traveling at a velocity of three to six kilometers per second (two to four miles per second) has been documented to create a 0.5 centimeter (0.2 inch) indention in the windshield of the Space Shuttle. In LEO, an aluminum sphere 0.13 centimeter (0.05 inch) in diameter has damage potential similar to that of a .22-caliber long rifle bullet. An aluminum sphere one centimeter (0.4 inch) in diameter is comparable to a 181-kilogram (400-pound) safe traveling at 97 kilometers per hour (60 miles per hour). A fragment 10 centimeters (3.9 inches) long is roughly comparable to 25 sticks of dynamite. In general, debris smaller than 0.1 centimeter (0.04 inch) in size does not pose a hazard to spacecraft functionality. Debris from 0.1 centimeter (0.04 inch) to one centimeter (0.4 inch) in size may or may not penetrate a spacecraft, depending on material and whether shielding is used. However, penetration through a critical component, such as the flight computer or propellant tank, can result in loss of the spacecraft. Debris fragments between one and 10 centimeters (0.4 and 3.9 inches) in size will penetrate and damage most spacecraft. Astronauts or cosmonauts engaging in extra-vehicular activities could be vulnerable to the impact of small debris. On average, debris

1 millimeter (0. 04 inch) is capable of perforating current U.S. space suits. (Cour-Palais, 1991, as referenced in Commission on Engineering and Technical Systems, 1995)

In general, any orbital debris produced by BMDS activities would likely be small, primarily consisting of explosive bolts and small pieces of hardware. It may also be possible for debris related to an intercept to become orbital debris. However, because the majority of BMDS activities would occur in LEO where debris would gradually drop into successively lower orbits and eventually reenter the atmosphere, the debris would not be a significant hazard to the ISS. As BMDS testing becomes more realistic, there is potential for an increased amount of debris reaching and remaining on orbit. Most of this debris would likely not remain on orbit for more than one revolution, and eventually all of the debris would de-orbit. NASA and its ISS partners may be able to implement mitigation strategies to further reduce the impacts to the ISS from orbital debris. NASA and the U.S. Air Force Space Command monitor orbiting space objects and are aware of instances when the ISS is predicted to be in proximity to space debris that has the potential to damage spacecraft.

MDA would evaluate risk to existing space assets prior to test launches as indicated in Appendix L Orbital Debris. MDA would use launch window screening and schedule tests to eliminate risk of BMDS intercept debris impacting the ISS. Because the debris produced by BMDS activities would be expected to be small and would eventually be removed from orbit, and MDA would schedule launches to avoid the ISS, there would be no significant impacts expected to the ISS from the implementation of Alternative 2 for the BMDS PEIS.

4.3 No Action Alternative

Under the No Action Alternative, the MDA would not develop, test, deploy, or plan for decommissioning activities for an integrated BMDS. Instead, the MDA would continue existing test and development of individual missile defense systems as stand-alone capabilities. Under the No Action Alternative, individual components would continue to be tested to determine the adequacy of their stand-alone capabilities, but they would not be subjected to System Integration Tests. Further, C2BMC architecture would be designed to meet individual components needs and would not be designed or tested to meet the needs of an integrated system. The No Action Alternative would not allow for the effective development of an integrated BMDS to defend against threat missiles in all flight phases.

The No Action Alternative involves the continuation of current MDA activities for individual weapons, sensors, C2BMC, and support assets and would not include integration or System Integration Testing of these components. For the potential sites being considered for deployment, the No Action Alternative would be a continuation of activities currently occurring or planned at those locations. Therefore, the environmental

impacts associated with the No Action Alternative would be the same as the impacts resulting from existing activities assuming no integration. Because System Integration Testing would not occur under the No Action Alternative, the impacts associated with this testing would not occur.

The decision not to develop and field a fully integrated BMDS could result in the inability to respond to a ballistic missile attack on the U.S. or its deployed forces, allies, or friends in a timely and successful fashion. Further, the No Action Alternative would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress.

4.4 Adverse Environmental Effects That Cannot Be Avoided

Adverse environmental effects that cannot be avoided include the removal of vegetation during site preparation and construction activities; minor short-term noise impacts startling of wildlife; deposition of small amounts of pollutants on land, air, and sea; minor increased generation of hazardous materials; and emission of EMR.

In general, most known adverse effects resulting from implementation of the BMDS would be mitigated through project planning and design measures, consultation with appropriate agencies, and the use of Best Management Practices. As a result, most potential adverse effects would be avoided and those that could not be avoided should not result in a significant impact to the environment. Consultation with the appropriate agencies would result in the development of mitigation measures needed to ensure that impacts remain at less than significant levels.

4.5 Relationship between Short-Term Use of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

Section 1502.16 of the CEQ NEPA Implementing Regulations; require that the relationship between short-term uses of the human environment and the maintenance and enhancement of long-term productivity be discussed.

Proposed BMDS activities would take advantage of existing facilities and infrastructure to the extent practicable. The implementation of the BMDS would not necessarily preclude the use of facilities and infrastructure for other purposes. Therefore, options for future use would not be eliminated.

4.6 Irreversible or Irretrievable Commitment of Resources

Implementing the BMDS would not be expected to result in the loss of threatened or endangered species or cultural resources. However, some irretrievable resources would be used (e.g., construction materials, fuel, and labor). Site preparation and construction activities would result in some minor loss of biological habitat and wetlands, but impacts

would be minimized through the implementation of mitigation measures. Sensitive biological habitat would be avoided to the extent practicable. Proposed BMDS activities would not irreversibly curtail the range of potential uses of the environment. There would be no preclusion of development of underground mineral resources that were not already constrained.

Although the proposed BMDS activities would result in some irreversible or irretrievable commitment of resources such as various construction materials, minerals, and labor, this commitment of resources is not significantly different from that necessary for many other defense research and development programs carried out over the past several years. Proposed activities would not commit natural resources in significant quantities.

4.7 Federal Actions to Address Protection of Children from Environmental Health Risks and Safety Risks (EO 13045, as Amended by EO 13296 and EO 13229)

This PEIS has not identified any environmental health and safety risks that may disproportionately affect children, in compliance with EO 13045 as amended by EO 13229.

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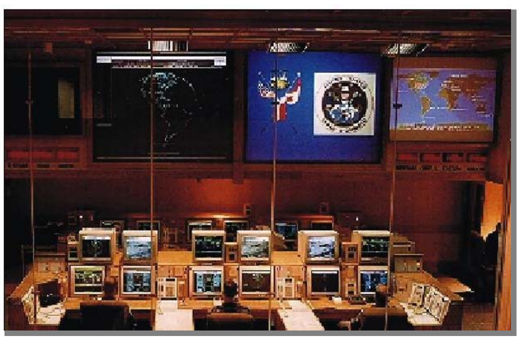

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Department of Defense
Missile Defense Agency
7100 Defense Pentagon
Washington, DC 20301-7100

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ACRONYMS AND ABBREVIATIONS

ABL	Airborne Laser
ABM	Anti-Ballistic Missile
ACHP	Advisory Council on Historic Preservation
AFB	Air Force Base
AFRL	Air Force Research Laboratory
AFSPC	Air Force Space Command
Ait	atmospheric interceptor technology
ALCOR	Advanced Research Project Agency Lincoln C-band Observable Radar
Al_2O_3	Aluminum Oxide (alumina)
ANSI	American National Standards Institute
AMOS	Air Force Maui Optical and Supercomputing Station
ARS	Active Ranging System
ARTCC	Air Route Traffic Control Center
ASIP	Arrow System Improvement Program
AST	Office of Commercial Space Transportation
AWS	Arrow Weapon System
BC/FC	Beam Control/Fire Control
BILL	Beacon Illuminator Laser
BMC2	Battle Management/Command and Control
BMC3	Battle Management/Command, Control and Communications
BMC4I	Battle Management Command, Control, Communications, Computers and Intelligence
BMD	Ballistic Missile Defense
BMDO	Ballistic Missile Defense Organization
BMDS	Ballistic Missile Defense System
BMEWS	Ballistic Missile Early Warning System
BOA	Broad Ocean Area
BTS	Bureau of Transportation Statistics
C2BM	Command and Control/Battle Management
C2BMC	Command and Control, Battle Management, and Communications
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Cl	Atomic Chlorine
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COIL	Chemical Oxygen Iodine Laser
COMSATCOM	Commercial Satellite Communications
D&T	Development and Test

dB	Decibel
dBA	A-weighted decibel
DoD	Department of Defense
DOT	Department of Transportation
DSP	Defense Support Program
EA	Environmental Assessment
EIS	Environmental Impact Statement
EKV	Exoatmospheric Kill Vehicle
EM	Electromagnetic
EMR	Electromagnetic Radiation
EO	Executive Order
EPA	Environmental Protection Agency
ESG	Engagement Sequence Group
ESQD	Explosive Safety Quantity Distance
ETR	Extended Test Range
EWR	Early Warning Radar
FAA	Federal Aviation Administration
FBX-T	Forward Based X-Band Radar Transportable
FL	Flight Level
FM	Flight Mission
FR	Federal Register
FTS	Flight Termination System
FY	Fiscal Year
GBR-P	Ground-Based Radar Prototype
GEO	Geosynchronous Earth Orbit
GFC	Ground-based Midcourse Defense Fire Control
GFC/C	Ground-based Midcourse Defense Fire Control/Communications
GMD	Ground-Based Midcourse Defense
GT	Integrated Ground Test
H_2	Hydrogen
H_2O	Water
HAA	High Altitude Airship
HAIR	High Accuracy Instrumentation Radar
HALO	High Altitude Observatory
HAP	Hazardous Air Pollutant
HEL	High Energy Laser
HCl	Hydrogen Chloride
ICAO	International Civil Aviation Organization
ICBM	Inter-Continental Ballistic Missile
IDC	Initial Defensive Capability
IDLH	Immediately Dangerous to Life and Health
IDO	Initial Defensive Operations
IDT	In-Flight Interceptor Communication System Data Terminal

IEEE	Institute of Electrical and Electronics Engineers
IFR	Instrument Flight Rules
INF	Intermediate-Range Nuclear Forces
IRST	Infrared Search and Track
ISS	International Space Station
ISTEF	Innovative Science and Technology Experimentation Facility
KEI	Kinetic Energy Interceptor
KLC	Kodiak Launch Complex
LEO	Low Earth Orbit
Lidar	Light Detection and Ranging
LRAD	Long Range Atmospheric Defense
MARTI	Missile Alternative Range Target Instrument
MDA	Missile Defense Agency
MDIE	Missile Defense Integration Exercises
MEADS	Medium Extended Air Defense System
mg/m^3	Milligrams per cubic meter
MILSATCOM	Military Satellite Communications
MOA	Military Operating Area
MPE	Maximum Permissible Exposure
MSL	Mean Sea Level
MSSS	Maui Space Surveillance System
MSX	Midcourse Space Experiment
N_2	Nitrogen
NAAQS	National Ambient Air Quality Standards
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NFIRE	Near-Field Infrared Experiment
NMD	National Missile Defense
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
OCONUS	Outside the Continental United States
OSHA	Occupational Safety and Health Administration
PAC-3	PATRIOT Advanced Capability-3
PAVE PAWS	Position and Velocity Extraction Phased Array Warning System
PEIS	Programmatic Environmental Impact Statement
PEL	Permissible Exposure Limit
ppb	parts per billion

ppm	parts per million
PM	Particulate Matter
PM_{10}	Particulate Matter with diameter 10 microns or less
$PM_{2.5}$	Particulate Matter with diameter 2.5 microns or less
PMRF	Pacific Missile Range Facility
RCC	Range Commanders' Council
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RTS	Ronald Reagan Ballistic Missile Defense Test Site
SBIRS	Space-Based Infrared Sensor
SBX	Sea-Based X-Band Radar
SDI	Strategic Defense Initiative
SHEL	Surrogate High Energy Laser
SIFT	System Integration Flight Test
SIL	Systems Integration Laboratory
SIP	State Implementation Plan
SM	Standard Missile
SO_2	Sulfur Dioxide
SO_X	Sulfur Oxides
SPCC	Spill Prevention, Control and Countermeasure
START	Reduction and Limitation of Strategic Offensive Arms Treaty
STEL	Short Term Exposure Limit
STSS	Space Tracking and Surveillance System
THAAD	Terminal High Altitude Area Defense
TILL	Track Illuminator Laser
TLV	Threshold Limit Value
TMD	Theater Missile Defense
TPS-X	Transportable System Radar
UCAR	University Corporation for Atmospheric Research
UNEP	United Nations Environment Programme
U.S.	United States
USAF	United States Air Force
USAKA	U.S. Army Kwajalein Atoll
USFWS	U.S. Fish and Wildlife Service
U.S.C.	United States Code
USGS	United States Geological Survey
VFR	Visual Flight Rules
VOC	Volatile Organic Compound
WASP	Widebody Airborne Sensor Platform
WSMR	White Sands Missile Range
XBR	X-Band Radar

APPENDIX A
CONSULTATION AND COORDINATION

CONSULTATION AND COORDINATION

Relevant legislative requirements dictated which entities the Missile Defense Agency (MDA) consulted, and although there are three main resource areas that require consultation and programmatic agreements, MDA worked with additional organizations to ensure completeness of the National Environmental Policy Act (NEPA) process.

The MDA met with the Council on Environmental Quality (CEQ) to discuss general consultation requirements, but formal consultation and a programmatic agreement with CEQ were not required due to the general nature of CEQ's involvement with the NEPA process. Based on requirements in the Fish and Wildlife Preservation Act and the Endangered Species Act, the MDA consulted with the United States (U.S.) Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries Service) to determine what effects the proposed Ballistic Missile Defense System (BMDS) will have on wildlife and critical habitat. Based on requirements in the National Historic Preservation Act, the MDA consulted with the Advisory Council on Historic Preservation (ACHP) to determine what effects the proposed BMDS will have on historic properties.

Agency	Date Consulted	Point of Contact	Address
ACHP	11 February 2004	Dave Berwick Army Affairs Coordinator, Office of Federal Agency Programs	1100 Pennsylvania Avenue, NW, Room 803 Washington, DC 20004 Phone: (202) 606-8531
		Don Klima Director, Office of Federal Agency Programs	1100 Pennsylvania Avenue, NW, Room 809 Washington, DC 20004 Phone: (202) 653-8503
CEQ	19 December 2003	Horst Greczmiel Associate Director for NEPA Oversight	722 Jackson Place, N.W. Washington, DC 20503 Phone: (202) 395-5750
NOAA Fisheries	14 January 2004	Steve Kokkinakis NEPA Coordinator, U.S. Department of Commerce, NOAA	1315 East-West Highway Silver Spring, Maryland 20910 Phone: (301) 713-1622 ext.189
		David Kaiser Federal Consistency and Regulatory Coordinator, Coastal Programs Division, N/ORM3	1315 East-West Highway Silver Spring, Maryland 20910 Phone: (301) 713-3155 ext.144

Agency	Date Consulted	Point of Contact	Address
		John Hansel Office of Protected Resources	1315 East West Highway Silver Spring, MD 20910 Phone: (301) 713-2332
USFWS	4 February 2004	John Fay Staff Biologist, Division of Consultation, Habitat Consultation Planning, Recovery and State Grants, USFWS Endangered Species Program	4401 North Fairfax Drive Room 420 Arlington, Virginia 22203 Phone: (703) 358-2106
		Rick Sayers Chief, Division of Consultation, Habitat Consultation Planning, Recovery and State Grants, USFWS Endangered Species Program	4401 North Fairfax Drive Arlington, Virginia 22203 Phone: (703) 358-2106
		Laura Henze National Sikes Act Coordinator, Branch of Resource Management Support	4401 North Fairfax Drive Arlington, Virginia 22203 Phone: (703) 358-2398

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APPENDIX B
PUBLIC INVOLVEMENT

PUBLIC INVOLVEMENT

The CEQ implementing regulations for NEPA describe the public involvement requirements for agencies (40 Code of Federal Regulations [CFR] 1500-1508). Public participation in the NEPA process not only provides for and encourages open communication between the MDA and the public, but also promotes better decision-making. Throughout preparation of the BMDS Programmatic Environmental Impact Statement (PEIS), the MDA aimed to

- Obtain meaningful input concerning the issues that should be addressed in the BMDS PEIS,
- Provide interested parties, especially the public, with accurate and timely information concerning the MDA's efforts to meet NEPA requirements in the BMDS PEIS process,
- Ensure meaningful public involvement during scoping and the public review of the Draft PEIS,
- Ensure that the MDA responded to inquiries and comments in a timely manner and discuss how input was considered, and
- Ensure that the MDA recognized and responded to changing stakeholder needs for input and involvement in a timely and informative way.

B.1 Scoping

The CEQ implementing regulations for NEPA require an open process for determining the scope of issues related to the proposed action and alternatives. The scope consists of the range of actions, alternatives, and impacts to be considered in the PEIS. Scoping is a useful tool for discovering alternatives to a proposed action, identifying significant impacts, eliminating insignificant issues, communicating information, consulting with agencies and organizations, and soliciting public comments. During scoping, the MDA invited the participation of Federal, state, and local agencies, Native American Tribes, environmental groups, organizations, citizens, and other interested parties to assist in determining the scope and significant issues to be evaluated in the BMDS PEIS.

Scoping for the development of the BMDS PEIS began with the publication of the Notice of Intent (NOI) in the *Federal Register* (FR) (Vol. 68, No. 70 FR 17784) on April 11, 2003. The NOI announced the MDA's intent to prepare a PEIS on the proposed BMDS; provided information on the proposed action and reasonable alternatives, including the no action alternative; listed the dates and locations of scoping meetings; and provided contact information for submitting comments to the MDA. The NOI is shown in Exhibit B-1.

Exhibit B-1. Notice of Intent

SUPPLEMENTARY INFORMATION: The Advisory Committee to the U.S. Section to ICCAT will meet in two open sessions to receive and discuss information on (1) the 2002 ICCAT meeting results and U.S. implementation of ICCAT decisions; (2) 2003 ICCAT and NMFS research and monitoring activities; (3) 2003 Commission activities; (4) results of the Committee's Species Working Group deliberations; and (5) Advisory Committee operational issues. The public will have access to the open sessions of the meeting, but there will be no opportunity for public comment.

The Advisory Committee will go into executive session during the afternoon of April 30, 2003, to discuss sensitive information relating to (1) post ICCAT 2002 discussions and negotiations, including upcoming ICCAT working group meetings on trade and on monitoring and compliance; (2) the Atlantic Tunas Convention Act required consultation on the identification of countries that are diminishing the effectiveness of ICCAT; and (3) other matters relating to the international management of ICCAT species. In addition, the Committee will meet in its Species Working Groups for a portion of the afternoon of April 30 and part of the morning of May 1, 2003. These sessions are not open to the public, but the results of the deliberations of the Species Working Groups will be reported to the full Advisory Committee during the Committee's afternoon open session on May 1.

Special Accommodations

The meeting location is physically accessible to people with disabilities. Requests for sign language interpretation or other auxiliary aids should be directed to Kim Blankenbeker at (301) 713–2276 at least 5 days prior to the meeting date.

Dated: April 8, 2003.

Richard W. Surdi,

Acting Deputy Director, Office of Sustainable Fisheries, National Marine Fisheries Service.

[FR Doc. 03–8934 Filed 4–10–03; 8:45 am]

BILLING CODE 3510–22–S

DEPARTMENT OF THE DEFENSE

Office of the Secretary

Notice of Intent To Prepare a Programmatic Environmental Impact Statement for the Ballistic Missile Defense System

AGENCY: Missile Defense Agency, Department of Defense.

ACTION: Notice of intent.

SUMMARY: The Missile Defense Agency (MDA) is publishing this notice to announce its intent to prepare a Programmatic Environmental Impact Statement (PEIS) in accordance with the National Environmental Policy Act of 1969 and the Council on Environmental Quality implementing regulations. This PEIS will assess environmental issues associated with the proposed action, foreseeable future actions, and their reasonable alternatives, including the no action alternative, and as appropriate, cumulative effects. This PEIS will support decisions to meet the fundamental objectives of the MDA's mission to test, develop, transfer to deployment, and to plan for decommissioning activities for a Ballistic Missile Defense System to defend the forces and territories of the United States (U.S.), its Allies, and friends against all classes of ballistic missile threats, in all phases of flight.

Scoping: Public scoping meetings will be conducted as a part of the PEIS process to ensure opportunity for all interested government and private organizations, and the general public to identify their issues of concern they believe should be addressed in the content of the PEIS. Schedule and location for the public scoping meetings are:

- April 30, 2003, 6 p.m., Doubletree Hotel, 300 Army Navy Dr., Arlington, VA.
- May 06, 2003, 6 p.m., Sheraton Grand Hotel, 1230 J. St., Sacramento, CA.
- May 08, 2003, 6 p.m., Sheraton Hotel, 401 E. 6th Ave., Anchorage, AK.
- May 13, 2003, 6 p.m., Doubletree Hotel, 1956 Ala Moana Blvd., Honolulu, HI

For those that cannot attend the public scoping meetings, written comments via the U.S. mail, or e-mail are encouraged. Comments should clearly identify and describe the specific issue(s) or topics that the PEIS should address. Comments are welcomed anytime throughout the PEIS process. Formal opportunities for comment and participation include: (1) Public scoping meetings; (2) anytime during the process via mail, telephone, fax, or e-mail; (3) during review, public hearings, and comment on the Draft PEIS; and, (4) review of the Final PEIS. Interested parties may also request to be included on the mailing list for public distribution of the PEIS.

To ensure sufficient time to consider issues identified during the public scoping meeting period, comments should be submitted to one of the addresses listed below no later than June 12, 2003. Additional information regarding the development of the BMDS PEIS is available on the public participation Web site *http://www.acq.osd.mil/bmdo.*

ADDRESSES: Written comments, statements, and/or questions regarding scoping issues should be addressed to: MDA BMDS PEIS, c/o ICF Consulting, 9300 Lee Highway, Fairfax, VA 22031, Phone (Toll Free) 1–877–MDA–PEIS (1–877–632–7347), Fax (Toll Free) 1–877–851–5451, E-mail *bmds.peis@mda.osd.mil.* Web site *http://www.acq.osd.mil/bmdo.*

Dated: April 7, 2003.

L.M. Bynum,

Alternate OSD Federal Register Liaison Officer, Department of Defense.

[FR Doc. 03–8897 Filed 4–10–03; 8:45 am]

BILLING CODE 5001–08–M

DEPARTMENT OF DEFENSE

Department of the Air Force

Proposed Collection; Comment Request

AGENCY: Department of Defense Medical Examination Review Board, Department of Defense.

ACTION: Notice.

In compliance with section 3506(c)(2)(A) of the Paperwork Reduction Act of 1995, the Department of Defense Medical Examination Review Board announces the proposed public information collection and seeks public comment on the provisions thereof. Comments are invited on: (a) Whether the proposed collection of information is necessary for the proper performance of the functions of the agency, including whether the information shall have practical utility; (b) the accuracy of the agency's estimate of the burden of the proposed information collection; (c) ways to enhance the quality, utility, and clarity of the information to be collected; and (d) ways to minimize the burden of the information collection on respondents, including through the use of automated collection techniques or other forms of information technology.

DATES: Considerations will be given to all comments received by June 10, 2003.

ADDRESSES: Written comments and recommendations on the proposed information collection should be sent to Department of Defense Medical Examination Review Board (DoDMERB), 8034 Edgerton Drive, Suite 132, USAF Academy, CO 80840–2200, Attention: CMSgt Jaime P. Bouchard.

FOR FURTHER INFORMATION CONTACT: To request more information on this

The MDA developed a web site, http://www.mda.mil/mdalink/html/mdalink.html, to provide information on the BMDS PEIS and solicit scoping comments. The web site includes a schedule and summaries of the scoping meetings; background information about the NEPA process, the BMDS, and the PEIS; and links to relevant web sites. In addition, the web site provides an electronic comment form for individuals to submit scoping comments directly to the MDA. The MDA also established a toll-free phone line, toll-free fax, e-mail address, and mailbox for submittal of public comments and questions.

The MDA held public scoping meetings in accordance with CEQ regulations. The purpose of the scoping meetings was to solicit input from the public on concerns regarding the proposed activities, as well as information and knowledge of issues relevant to analyzing the environmental impacts of the BMDS. The public scoping meetings also provided the public with an opportunity to learn more about the MDA's proposed action and alternatives. MDA personnel were available at the scoping meetings to explain the objectives of the BMDS PEIS process.

The scoping meetings consisted of informal poster sessions; formal presentations by MDA officials on the proposed BMDS, the NEPA process, and public involvement; and a formal public comment session. The MDA provided background and information materials to those who attended the scoping meetings and provided numerous ways to submit comments and obtain additional information. A court reporter was present at each of the meetings to document the proceedings, including public comments, for the administrative record. Issues highlighted at the public scoping meetings were posted on the BMDS PEIS web site.

Scoping Meeting Legal Notices

In addition to announcing the public scoping meetings in the NOI, the MDA placed paid legal notices in local and regional publications. Exhibit B-2 summarizes the publications in which the scoping meetings were advertised, including publication dates.

Exhibit B-2. Local and Regional Publications and Dates

Scoping Meeting Location	Newspaper	Publication Date(s)
Arlington, VA	Journal Newspapers: Alexandria County, VA; Arlington County, VA; Fairfax County, VA; Montgomery County, MD; Prince George's County, MD; Prince William County, VA	April 24, 2003 April 25, 2003
Sacramento, CA	Sacramento Bee	April 30, 2003 May 4, 2003
	Lompoc Record	April 29, 2003 May 1, 2003 May 2, 2003 May 4, 2003
Anchorage, AK	Anchorage Daily News	April 30, 2003 May 4, 2003
	Fairbanks Daily News-Miner	May 1, 2003
	Kodiak Daily Mirror	April 30, 2003 May 2, 2003
Honolulu, HI	Honolulu Star-Bulletin	May 4, 2003 May 6, 2003
	Honolulu Advertiser	May 5, 2003 May 7, 2003
	Garden Island Newspaper, Kauai, HI	May 5, 2003 May 7, 2003
	The Environmental Notice (Office of Environmental Quality Control)	May 8, 2003

Scoping Meeting Notification Letter

The MDA sent letters and a copy of the NOI to state governors, mayors, and members of Congress indicating the MDA's intent to prepare a PEIS for the BMDS and dates of scoping meetings. Exhibit B-3 lists the recipients of the scoping meeting notification letter. An example of the notification letter is also included in Exhibit B-4.

Exhibit B-3. Scoping Meeting Notification List

City of Honolulu Jeremy Harris, Mayor Honolulu Hale 530 South King Street Honolulu, HI 96813	City of Kodiak Carolyn L. Floyd, Mayor 710 Mill Bay Road Kodiak, AK 99615
County of Kauai Brian J. Baptiste, Mayor Office of the Mayor 4444 Rice Street, Suite 235 Lihue, HI 96766	Brigadier General Craig E. Campbell The Adjutant General Alaska Air National Guard Fort Richardson, AK 99505
City of Sacramento Heather Fargo, Mayor 730 I Street, Suite 321 Sacramento, CA 95814	Major General Paul D. Monroe, Jr. The Adjutant General 9800 Goethe Road Sacramento, CA 95827
City of Lancaster Frank C. Roberts, Mayor 44933 North Fern Avenue Lancaster, CA 93534	Major General Robert G. F. Lee The Adjutant General 3049 Diamond Head Road Honolulu, HI 968-4495, CA 95827
City of Lompoc Dick DeWees, Mayor 100 Civic Center Plaza Lompoc, CA 93438	Honorable Frank H. Murkowski Governor of Alaska P.O. Box 110001 Juneau, AK 99811-0001
City of Anchorage Mayor George Wuerch 632 West 6th Avenue, Suite 840 Anchorage, AK 99519-6650	Honorable Gray Davis Governor of California State Capital Building Sacramento, CA 95814
City of Fairbanks Rhonda Boyles, Mayor 809 Pioneer Road Fairbanks, AK 99707	Honorable Linda Lingle Governor of Hawaii State Capital Executive Chambers Honolulu, HI 96813
Delta Junction Thomas "Roy" Gilbertson, Mayor P.O. Box 1069 Delta Junction, AK 99737	Honorable Neil Abercrombie House of Representatives Washington, DC 20515
City of Delta Junction City Official P.O. Box 229 Delta Junction, AK 99737-0229	Honorable Daniel Akaka United States Senate Washington, DC 20510
Honorable Barbara Boxer United States Senate Washington, DC 20510	Honorable Dianne Feinstein United States Senate Washington, DC 20510

Exhibit B-3. Scoping Meeting Notification List

Honorable Daniel Inouye United States Senate Washington, DC 20510	Honorable Don Young House of Representatives Washington, DC 20515
Honorable Robert Matsui House of Representatives Washington, DC 20515	Honorable Lisa Murkowski United States Senate Washington, DC 20510
Honorable Ted Stevens Chairman Subcommittee on Defense Committee on Appropriations United States Senate Washington, DC 20510	Honorable Jerry Lewis Chairman Subcommittee on Defense Committee on Appropriations House of Representatives Washington, DC 20515
Honorable Duncan Hunter Chairman Committee on Armed Services House of Representatives Washington, DC 20515	Honorable John Warner Chairman Arms Service Committee United States Senate Washington, DC 20510

Exhibit B-4. Example of Scoping Meeting Notification Letter

DEPARTMENT OF DEFENSE
MISSILE DEFENSE AGENCY
7100 DEFENSE PENTAGON
WASHINGTON, DC 20301-7100

APR 7 2003

Honorable Don Young
House of Representatives
Washington, DC 20515

Dear Representative Young:

The Missile Defense Agency (MDA) is preparing a Programmatic Environmental Impact Statement (PEIS) to address the potential environmental effects associated with research, development, test, evaluation, deployment, and decommissioning of the Ballistic Missile Defense System (BMDS). The BMDS is a system of systems consisting of layered defenses using complementary sensors and weapons to engage threat ballistic missiles in all phases of flight. Since completing our 1994 PEIS, we have been developing and testing new technologies and are now preparing a new PEIS to reflect our current mission and the evolving BMDS. The BMDS PEIS will provide the framework to plan and evaluate the range of complex activities comprising the BMDS from test and development through fielding and decommissioning.

The MDA is holding scoping meetings in April and May 2003 to encourage public participation and to solicit public comment on the proposed activities. The attached Notice of Intent provides the meeting dates and locations in your congressional area.

Please contact Ms. Pamelia Bain, MDA Legislative Affairs, at (703) 697-8980, if you have any questions regarding this matter.

Sincerely,

RONALD T. KADISH
Lieutenant General, USAF
Director

Enclosure:
As stated

Communications with Media

The MDA's Office of the Director of Communications notified local media representatives about the public scoping meetings and distributed press releases. Exhibit B-5 lists the media representatives contacted by the MDA. An example of the press release is also included in Exhibit B-6.

Exhibit B-5. Media Representatives Contacted

Scoping Meeting Location	Media Organizations Contacted	
Arlington, VA	**Newspaper**	**Radio/Television**
	Bill Gertz, Washington Times Bradley Graham, Washington Post Northern Virginia Journal Rowan Scarborough, Washington Times	Brian Hartman, ABC News Jeff Seldin, WTOP News WTTG-TV
Sacramento, CA	**Newspaper**	
	J. Hulse, Santa Barbara News Press P. Dinsmore, Sacramento Bee R. Rodriguez, Sacramento Bee R. Rodriguez, Santa Barbara News Press Valerie Mercado, Lompoc Record	
Anchorage, AK	**Newspaper**	**Radio/Television**
	Alaska Journal of Commerce Anchorage Daily News Fairbanks Daily News-Miner Juneau Empire Kodiak Daily Mirror Valdez Star	APRN-Anchorage B. Miller, KTVF Channel 11 NBC KIMO Channel 13 ABC KTUU Channel 2 NBC KTVA Channel 11 CBS
Honolulu, HI	**Newspaper**	**Radio/Television**
	Garden Island Newspaper Honolulu Advertiser Steven Petranik, Honolulu Star Bulletin Tony Summer, Honolulu Star Bulletin	Brenda Salgado, 9 CBS (KGMB) Jon Shimabakura, News 8 NBC Mark Matsunaga, Fox 2 Michael Gaede, Fox 2 Wanda Wehr, News 4

Exhibit B-6. Example of Scoping Meeting Press Release

Missile Defense Agency to Hold Public Scoping Meeting

Arlington, Virginia – The Missile Defense Agency (MDA) is hosting a scoping meeting on Wednesday April 30th from 6-9 p.m. at the Doubletree Hotel in Arlington, VA. The scoping meeting is being held as part of preparation of a Programmatic Environmental Impact Statement (PEIS) on the Ballistic Missile Defense System.

This PEIS will assess environmental issues associated with the proposed action, foreseeable future actions, and their reasonable alternatives, including the no action alternative, and as appropriate. cumulative effects. This PEIS is being conducted in accordance with the National Environmental Policy Act of 1969 and the Council on Environmental Quality implementing regulations.

Public scoping meetings are conducted as part of the PEIS process to ensure opportunity for all interested government and private organizations, and the general public to identify issues of concern they believe should be addressed in the content of the PEIS.

This PEIS will support decisions to meet the fundamental objectives of the MDA's Mission to test, develop, transfer to deployment and to plan for decommissioning activities for a Ballistic Missile Defense System to defend the forces and territories of the United States, it's Allies, and friends against all classes of ballistic missile threats, in all phases of flight.

In addition to attending the meeting, the public may submit comments until June 12, 2003 using the following resources:

US Mail: MDA BMDS PEIS, c/o ICF Consulting 9300 Lee Highway Fairfax, VA 22301

Toll-free 1-877-851-5451 (please leave your name, address and comments)

Email: bmds.peis@mda.osd.mil

Website: http://www.acq.osd.mil/bmdo/peis/html/home.html

Media wishing to attend the meeting or having any further questions should contact Major Catherine Reardon, 703-697-8491; Mr. Chris Taylor, 703-697-8001 or Mr. Rick Lehner, 703-697-8997.

-30-

Summary of Public Scoping Meetings

Exhibit B-7 provides a summary of attendees and comments provided at the public scoping meetings.

Exhibit B-7. Public Scoping Meeting Attendees and Comments Provided

City	Date	Number of Attendees	Number of Attendees Providing Oral Comments	Number of Attendees Providing Written Comments
Arlington, VA	April 30, 2003	15	0	0
Sacramento, CA	May 6, 2003	19	8	2
Anchorage, AK	May 8, 2003	19	4	5
Honolulu, HI	May 13, 2003	8	3	0

Approximately 14 protesters in Sacramento and 12 protesters in Anchorage gathered prior to and during the scoping meetings. Representatives from a television station and a radio station attended the Anchorage meeting and interviewed MDA representatives. One meeting participant in Honolulu videotaped the scoping meeting to be broadcast on local public television.

Regulator and Agency Outreach Efforts

While on travel for scoping meetings, MDA personnel provided informational briefings to various regulatory and agency officials. In Alaska, a briefing was given to officials within the Department of Environmental Conservation and to a member of the U.S. Army Corps of Engineers. In Hawaii, a briefing was given to an interagency environmental group created by the Space and Missile Defense Command, which meets quarterly to address relevant environmental issues in Hawaii. Attorneys with the U.S. Army Pacific and U.S. Army Alaska Staff Judge Advocate offices were briefed as well.

Summary of Scoping Comments

The MDA requested scoping comments be submitted by June 12, 2003 to be considered in developing the Draft BMDS PEIS. Following completion of scoping, the MDA categorized comments received according to content and analyzed the comments to determine issues of priority to the interested parties, level of detail to be included in the

Draft BMDS PEIS, sources of information to be used, and issues to be addressed and evaluated in the Draft BMDS PEIS.

During scoping, MDA received a total of 285 comments via e-mail (62 percent), toll-free fax (11 percent), the BMDS PEIS web site (three percent), mail (12 percent), toll-free phone line (five percent), and during the scoping meetings (oral - five percent and written - two percent). Approximately 84 percent of comments were from private citizens, less than four percent represented non-government organizations, less than one percent represented government agencies, and less than seven percent represented other groups including media and religious organizations. Approximately 21 percent of comments received appeared to be derived from NGO-provided templates or form letters.

The MDA identified key issues addressed in the scoping comments and sorted the comments based on these issue areas. The comments included issues both within and outside of the scope of the Draft BMDS PEIS. Types of issues considered "in scope" related to the resource areas analyzed in the Draft BMDS PEIS; feasible alternatives; laws and regulations; affected regions; specific hazards, such as perchlorate contamination and debris; and BMDS activities, such as decommissioning.

The majority of comments were considered to be outside the scope of the Draft BMDS PEIS. These comments were related to the opposition to the BMDS, especially with regard to the use of space as a weapons platform; concern that the program would bankrupt the economy and that Federal funds should be channeled to address socioeconomic problems, better health care and insurance coverage, and education; and concern that the BMDS would create an arms race, especially in space. Other key issues included opposition to development of nuclear weapons and concern that missile defense could be a first strike capability for U.S. worldwide military domination.

Exhibit B-8 summarizes the number of comments received from the public related to resource areas; human health and environmental impacts; alternatives; and Department of Defense (DoD) policy, budget, and program issues. Many comments received addressed multiple issues. Exhibit B-9 includes representative examples of the comments received for each topic. Inclusion of representative excerpts seeks to eliminate duplicative comments that were received on each topic.

Exhibit B-8. Issues Addressed in Scoping Comments

Type of Issue	Issue	Number of Comments
Resource Areas (In Scope)	Air Quality	7
	Airspace	2
	Biological Resources	12
	Cultural and Historical Resources	3
	Environmental Justice	1
	Geology and Soils	6
	Hazardous Materials and Hazardous Waste	18
	Health and Safety	27
	Land Use	9
	Noise	0
	Socioeconomics	6
	Transportation	0
	Utilities	4
	Visual Resources	0
	Water Resources	13
Other Issues (In Scope)	Perchlorate	14
	Debris	4
	Effects from testing or use of nuclear or radioactive materials	20
	Local/international laws	5
	Areas to be affected	6
	Alternatives	13
	Decommissioning	4
	Deployment	1
	Need to obtain input from scientists and technical experts	6
	General effects on environment	15
DoD Budget and Policy (Out of Scope)	Consideration of high cost of BMDS	145
	Less funding is available for other services	184
	BMDS destabilizes the world and increases the risk of an arms race	134
	BMDS decreases security	82
	BMDS benefits only corporations and GOP contributors	109
DoD Program (Out of Scope)	Opposition to BMDS	264
	Support for BMDS	4
	BMDS will not work	77

Exhibit B-8. Issues Addressed in Scoping Comments

Type of Issue	Issue	Number of Comments
	Opposition to nuclear weapons and weapons of mass destruction	76
	BMDS will lead to weaponization of space	108
	There is no threat to the U.S. and its allies	87
	BMDS does not address or raises the threat	51
	BMDS purpose is offensive, not defensive	79

Exhibit B-9. Scoping Comment Excerpts

Issue Area	Comment Number[1]	Comment Excerpt
Health and safety	E0179	The PEIS should give quantitative information on the reliabilities of the boosters to be used to launch targets for BMDS tests. I asked for this information in my comments on the 1994 BMD draft PEIS. The entire response in the 1994 BMD final PEIS (response 0047.014 on page 8-46) was "All boosters considered for use in BMD testing activities will have undergone rigorous reliability evaluation. Only highly reliable boosters will be used in order to protect the public and to ensure mission accomplishment." This response is inadequate for any meaningful assessment of the risks from launch failures.
Debris Health and safety	E0179	There are unresolved safety issues involving Strategic Target System and Terminal High Altitude Area Defense (THAAD) launches at PMRF. No detailed hazard areas have been shown for Strategic Target System launches at azimuths other than 280 degrees. Similarly, no diagrams showing the THAAD hazard area were given in the 2002 THAAD EA and no detailed analysis was cited to justify the reduction in the hazard area radius from 20,000 feet in the 1998 Pacific Missile Range Facility (PMRF) EIS to 10,000 feet in the THAAD EA.
Effects from testing/use of nuclear/radioactive materials	E0179	In addition to "hit-to-kill" interceptors and directed-energy weapons, there have been reports that interceptors armed with nuclear weapons are also being considered for missile defenses. The PEIS should indicate what research and development work is being planned for such weapons.
Local/international laws	E0179	The PEIS should examine in detail treaty compliance of various BMDS tests. In particular, the PEIS should examine INF Treaty restrictions on long-range air-launched targets. The PEIS should also examine Intermediate-Range Nuclear Forces (INF) and START Treaty restrictions on sea-launched targets. If compliance reviews have been done, references should be cited.

[1] The Comment Number column provides the number assigned to each scoping comment that was received. E = e-mail, F = fax, P = phone, M = mail, SMO = scoping meeting oral, SMW = scoping meeting written.

Exhibit B-9. Scoping Comment Excerpts

Issue Area	Comment Number[1]	Comment Excerpt
Air Geology and Soils Water Obtain input from scientists and technical experts	F0015 (M0029, M0030)[2]	If ballistic missile defense is coordinated with resumption of underground nuclear weapons testing, global fall-out, tectonic plates and geology are involved. Sea-based assets can obviously affect the ocean and air/space assets can affect the atmosphere. The complex questions involved here easily overwhelm any one particular professional group's expertise: thus, the more scientific input, the better.
Obtain input from scientists and technical experts	F0015 (M0029, M0030)	What more can be done to ensure meaningful response from leading scientific research in related fields and from the state Environmental Protection Agencies and other affected state agencies? At the very least, specialists in astrophysics, health physics, meteorology, climatology & atmospheric science, geology, soil science, limnology, oceanography, marine biology, medicine and psychology have vital but not all-inclusive expertise that should be part of the scoping process.
Effects from testing/use of nuclear or radioactive materials	F0015 (M0029, M0030)	The military has had discussion of nuclear-tipped interceptors: if a policy shift is planned from plain hit-to-kill technology to nuclear-tipped hits, will a new PEIS process be conducted? Nuclear-tipped BMDS increases potential for global fall-out. Indeed, radioactive fall-out from a terminal anti-ballistic missile (ABM) hitting an incoming nuclear missile can still pose grave consequences for the area presumed to be "protected" by the ABM.
Biological resources	F0015 (M0029, M0030)	Will the test platform in the Pacific Ocean involve use of sonar with its potential effects on marine mammal life? Will land-based assets involve extensive radar facilities in remote areas? Risks to endangered species have been raised as a concern at Vandenberg AFB as an example of environmental impact caused by facilities.

[2] The same comments were submitted via fax and mail (twice).

Exhibit B-9. Scoping Comment Excerpts

Issue Area	Comment Number[1]	Comment Excerpt
Hazardous Materials/Waste Health and Safety Perchlorate	F0015 (M0029, M0030)	What waste will be produced by the development, testing, deploying and decommissioning activities of BMDS and how will this waste be handled? Will any of this waste constitute hazardous materials? The answer is likely to be yes, given that perchlorate contamination results from rocket fuel. Perchlorate disrupts thyroid hormone function in humans and other animals.
Air	F0015 (M0029, M0030)	Directed energy missile defense systems sound like they involve lasers. What effects will use of such lasers during testing or actual activation have on the layers of our atmosphere, including ozone and green house gas effects? Will this have an effect on global warming? How will communication and weather satellites be affected by space-based platforms?
Perchlorate	F0021	▪ Perchlorate at site 8 at Vandenberg AFB. ▪ Perchlorate throughout the state of California, principally in the Colorado River where irrigation water laced with perchlorate has contaminated Imperial Valley. ▪ Vandenberg AFB uses ammonium perchlorate.
Health and Safety	F0021	▪ Perchlorate has been shown to cause fetal damage and serious harm to children as well as nursing mothers. ▪ Missile explosions happen and are dangerous which cause beach closures to keep the burning, toxic cinders from harming people and animals, yet harm is unavoidable.
Hazardous Materials/Waste Land Use	F0021	Aerospace corporations such as Boeing Rocketdyne and Boeing Delta Mariner should not be allowed to operate until all toxic emittants and water contaminants are removed. Boeing should not be allowed to sell its Santa Susana lab land until all contaminants are cleaned thoroughly.
Biological Resources	F0021	Sea life should not be 'taken', harassed, or tortured for missile defense and should be banned.
Land Use	F0021	Housing and agricultural land in Northern Santa Barbara and Southern San Luis Obispo should be thoroughly tested for rocket toxics immediately. No housing projects should be

Exhibit B-9. Scoping Comment Excerpts

Issue Area	Comment Number[1]	Comment Excerpt
		considered around Vandenberg AFB unless the land is thoroughly tested for toxics. This includes Providence Landing.
Socioeconomics	F0021	Fishing and recreational activities should not be suspended for missile defense.
Effects from testing/use of nuclear or radioactive materials	F0021	Vandenberg AFB should identify toxic depleted uranium from 1990 launches if they exist. No depleted uranium or other radioactive materials should be used in rocket launches.
Health and Safety	F0021	High energy chemical lasers are dangerous and should not be used for missile defense; not in tests as planned for 2004 at Vandenberg AFB, not in deployment.
Effects from testing/use of nuclear or radioactive materials	F0022	▪ Whether or not any low-yield nuclear material will be used in/on the BMDS experimental weapon systems, satellites, interceptors, target missiles, boosters, X-Band Radar (XBR) Systems, etc. ▪ If any low-yield nuclear material will be stored at Research Development Test Sites. If yes, list test site locations. ▪ If depleted uranium will be used in/on target missiles, interceptors, satellites, booster, etc.
Areas to be affected	F0022	▪ List the Research Development Test Sites where target missiles will be launched to be intercepted by the Airborne Laser. ▪ Poker Flats Rocket Range is listed as a Research, Development Test Site Location on the Intermediate Nuclear Forces Treaty Memorandum of Understanding list (INF Treaty MOU), as is the Kodiak Launch Complex, Kodiak, Alaska, but Poker Flats has been ignored in Environmental Assessments or Environmental Impact Statements in connection to a defense test site location. Include information on Poker Flats if it will play a part in the BMDS testing. Also explain the connection these two site locations

Exhibit B-9. Scoping Comment Excerpts

Issue Area	Comment Number[1]	Comment Excerpt
		have in relationship to the INF Treaty MOU. One could assume that nuclear material could be tested at these two locations (low-yield nuclear-tipped interceptor launches e.g.)
Health and Safety	F0022	▪ List any potential accidental or environmental hazards which could occur if the Airborne Laser misses its target. ▪ Include detailed information on how High-Powered Microwaves (Directed Energy) will be used as part of the BMDS and the environmental hazards associated with their transmission into the atmosphere and ionosphere (include human EMR hazards).
Health and Safety Hazardous Materials/Waste Land Use Water	F0022	The Pentagon is willing to use U.S. citizens as guinea pigs by jeopardizing the safety and health of the public living near the locations of the Research and Development Test Sites in order to test the new weapons systems, with no regard to environmental hazards from "exploding" missiles and hazardous missiles which will have a detrimental effect on the land, water, and environment which will be passed on to future generations.
Information Source	F0027	▪ Are the overall binary effects on the environment of all the components listed in the MTCR Report: July 1, 1993; ITEM 4 – Category 11: Propellants and constituent chemicals for propellants (3) available to the public for independent scientific peer review via FOIA or any other method? ▪ What effects do laser weapons and halogens, i.e., propellants and constituent chemicals for propellants listed in the MTCR report: July 1, 1993; ITEM 4 – Category 11 have on the environment? ▪ Perchlorate Found in Plants, Animals at Six Sites in U.S. in 2001.
Orbital Debris	F0027	In addition to existing rocket and jet fuel contamination, already lower orbital space is full of space trash such as a fork, tools, and thousands of pieces of junk which are a hazard to astronauts, spacecraft, and the space station.
Hazardous Materials/Waste	F0031 (M0035)	The Scope of the BMDS PEIS should consider impacts of hazardous waste and materials and on Health and safety, Land use, Water Resources, and Biological resources of

Exhibit B-9. Scoping Comment Excerpts

Issue Area	Comment Number[1]	Comment Excerpt
Health and Safety Land Use Water Biological Resources		environmental contamination from toxic and hazardous components of rocket fuels and explosives.
Perchlorate	F0031 (M0035)	Toxic environmental contamination from ammonium perchlorate and other toxic and hazardous ingredients in rocket fuels clearly need to be included in the scope of the BMDS PEIS.
Perchlorate Information Sources	F0031 (M0035)	▪ Ammonium Perchlorate is well characterized as a thyroid hormone disruptor (http://www.ewg.org/reports/rocketscience/chap3.html). At high enough concentrations, perchlorate can affect thyroid gland functions, where it is mistakenly taken up in place of iodine. ▪ While most contaminated samples are in the 4 to 20 ppb levels, surveys of California water sources show several sites with perchlorate levels from 4 to 820 ppb. (http://www.ewg.org/reports/rocketwater/table1.php) ▪ The Missile Technology Control Regime (http://www.fas.org/asmp/campaigns/missiles/techannex.htm) lists several additional chemicals used as fuels or propulsive substances
Health and Safety Land Use Water Biological Resources	F0031 (M0035)	What is the composition of each rocket fuel, the toxicity of each individual component and the combined mixtures and what are the effects on Health and safety, Land Use, Water Resources and Biological resources? What are the exposures following storage, testing and use of such missile defense systems?
Decommissioning	F0031 (M0035)	Finally, how will these chemicals and mixtures be disposed at decommissioning and what are the effects on Health and Safety, Land use, Water resources, Biological resources?

Exhibit B-9. Scoping Comment Excerpts

Issue Area	Comment Number[1]	Comment Excerpt
Health and Safety	F0031 (M0035)	The scope of the BMDS PEIS should consider impacts on Health and Safety.
Effects from testing or use of nuclear or radioactive materials	F0031 (M0035)	▪ The Scope of the BMDS PEIS should consider Health and Safety with regards to the issues of nuclear fallout and resulting radioactive contamination leading to morbidity and mortality. ▪ The scope of the BMDS PEIS should consider environmental effects of the potential use of nuclear tipped interceptors or systems components on health and safety.
Utilities Health and Safety	F0031 (M0035)	The scope of the BMDS PEIS needs to consider effects on utilities, health and safety resulting from destruction of electrical circuits, civilian computers, medical equipment, utilities, etc. from ElectroMagnetic Pulses (EMP) generated by high altitude nuclear detonations. This definitely needs to be considered in the scope of the BMDS if any BMDS "advanced system" will use nuclear detonations.
Biological Resources Health and Safety	F0031 (M0035)	The scope of the BMDS PEIS needs to consider if high powered land, sea, air or spaced based BMDS lasers will endanger the health and safety of wildlife and humans.
Local/International Laws Alternatives	F0031 (M0035)	The scope of the BMDS PEIS needs to consider alternatives to the BMDS including restoring and enhancing arms control and nuclear disarmament treaties, and the US acting as a leader in disarmament rather than hyper-armament.
Alternatives	F0031 (M0035)	▪ Alternative 4: Preserving Space for non-military purposes. ▪ Alternative 5: Deployment of a much more limited land and or sea based BMDS that would offer protection from specific rogue nations on the US homeland.
Obtain input from scientist and technical experts	F0031 (M0035)	The following Non-Governmental Organizations should be considered as sources of information that should be considered on the direct, indirect, and cumulative environmental effects of the proposed land, sea, air, and spaced based BMDS along with interacting with US offensive first strike weapon systems: Global Network against Weapons and Nuclear Power in Space, Federation of American Scientists Military Space

Exhibit B-9. Scoping Comment Excerpts

Issue Area	Comment Number[1]	Comment Excerpt
		Page, Western States Legal Foundation, Union of Concerned Scientists, Physicians for Social Responsibility.
Biological Resources	F0031 (M0035)	The scope of the BMDS PEIS needs to consider effects on Biological Resources, including endangered species. Also will the BMDS be exempted from protection of threatened and endangered species as President Bush has requested for essentially all military facilities? How many endangered species will be lost, i.e., become extinct?
Hazardous Materials/Waste	M0027	There are still massive amounts of contamination left in the environment at military installations.
Health and Safety	M0027	The shift of resources away from cleanup and toward buildup means that the burden of military contaminants on human health and the environment will be growing rather than diminishing.
Perchlorate	M0027	Specific contaminants of concern include: perchlorates, PCBs, and petroleum products, among others.
Socioeconomics	M0027	The socioeconomic impact of decommissioning. The world is already littered with U.S. military waste. There are hundreds of facilities that were supposed to have been decommissioned, and yet are still there.
Air Quality Biological Resources Cultural and Historic Resources Geology and Soils Land Use Water Socioeconomics	M0027	The potential environmental impact of the facilities in Alaska, including: impacts from construction; possible impacts from rocket explosions in Alaska; impacts to air quality, water resources, wildlife, and of course impacts to Native people and subsistence uses of the environment.

Exhibit B-9. Scoping Comment Excerpts

Issue Area	Comment Number[1]	Comment Excerpt
Areas to be affected	M0027	Impacts to the community of Greely, which is already overwhelmed by the influx of commerce and construction workers to the area, and which lacks adequate health care and infrastructure to handle the growth.

B.2 Public Comment Period

The Notice of Availability of the Draft PEIS was published in the FR by the Environmental Protection Agency (EPA) on September 17, 2004. The NOA announced the availability of the Draft PEIS, initiated the public comment period for the NEPA process, and requested comments on the Draft PEIS. The MDA also published a NOA in the FR on September 17, 2004, which provided information on the proposed action and alternatives, listed the dates and locations of the public hearings, and provided contact information for submitting comments to the MDA. The NOA is shown in Exhibit B-10.

Exhibit B-10. Notice of Availability for the Draft BMDS PEIS

Furthermore, section 704(i)(1)(C) of the Act stipulates that the Department shall issue a countervailing duty order under section 706(a) of the Act effective with respect to entries of merchandise the liquidation of which was suspended, if the underlying investigation was completed. Finally, section 704(i)(1)(E) of the Act stipulates that the Department shall notify the petitioner, interested parties to the investigation, and the ITC of termination of the Agreement.

The GOB's request for termination of the Agreement is effective September 26, 2004. Because the GOB is withdrawing from the Agreement, the Department finds that suspension of the underlying investigation will no longer be in the public interest as of that date (*see* section 704(d)(1) of the Act). Therefore, the Department will direct U.S. Customs and Border Protection ("CBP") to suspend liquidation of all entries of hot-rolled flat-rolled carbon-quality steel products from Brazil effective September 26, 2004. Accordingly, pursuant to section 704(i)(1)(C) of the Act, the Department hereby issues a countervailing duty order effective September 26, 2004, which is 60 days from the official filing date of the termination request of the GOB.

Countervailing Duty Order

In accordance with section 706(a)(1) of the Act, the Department will direct CBP to assess, beginning on September 26, 2004, a countervailing duty equal to the amount of the net countervailable subsidy determined or estimated to exist.

We will instruct CBP to require a cash deposit for each entry equal to the countervailing duty ad valorem rates found in the Department's *Final Determination* of July 19, 1999, as listed below. These suspension-of-liquidation instructions will remain in effect until further notice. The "All Others Rate" applies to all producers and exporters of subject merchandise not specifically listed. The final countervailing duty ad valorem rates are as follows:

Manufacturer/exporter	Margin (percent)
Companhia Siderurgica Nacional ("CSN")	6.35
Usinas Siderurgicas de Minas Gerais, S.A ("USIMINAS")	9.67
Companhi Siderurgic Paulista ("COSIPA")	9.67
All others	7.81

This notice constitutes the countervailing duty order with respect to hot-rolled flat-rolled carbon-quality steel products from Brazil. Interested parties may contact the Department's Central Records Unit, room B–099 of the main Commerce building, for copies of an updated list of countervailing duty orders currently in effect. This notice is published in accordance with sections 704(i) and 777(i) of the Act. This order is published in accordance with section 706(a) of the Act.

Dated: September 13, 2004.

James J. Jochum,

Assistant Secretary for Import Administration.

[FR Doc. E4–2231 Filed 9–16–04; 8:45 am]

BILLING CODE 3510–DS–P

DEPARTMENT OF DEFENSE

Office of the Secretary

Notice of Availability of the Ballistic Missile Defense System Draft Programmatic Environmental Impact Statement

AGENCY: Missile Defense Agency, Department of Defense.

ACTION: Notice of availability and request for comment.

SUMMARY: In accordance with National Environmental Policy Act (NEPA) regulations, the Missile Defense Agency (MDA) is initiating a public review and comment period for a Draft Programmatic Environmental Impact Statement (PEIS). This notice announces the availability of the Ballistic Missile Defense System (BMDS) Draft PEIS, which analyzes the potential impacts to the environment as MDA proposes to develop, test, deploy, and plan for decommissioning activities to implement an integrated MDBS. This Draft PEIS addresses the integrated BMDS and the development and application of new technologies; evaluates the range of complex programs, architecture, and assets that comprise the BMDS; and provides the framework for future environmental analyses as activities evolve and mature. The Draft PEIS has been prepared in accordance with NEPA, as amended (42 U.S.C. 4321, *et seq.*), and the Council on Environmental Quality Regulations for implementing the procedural provisions of NEPA (40 CFR parts 1500–1508).

DATES: The public comment period for the NEPA process begins with the publication of this notice and request for comments in the Federal Register. Public hearings will be conducted as a part of the PEIS development process to ensure opportunity for all interested government and private organizations and the general public to provide comments on the environmental areas considered in the Draft PEIS. Schedule and location for the public hearings are:

- October 14, 2004, 6:30 p.m., Marriott Crystal City, 1999 Jefferson Davis Highway, Arlington, VA.
- October 19, 2994, 6 p.m., Sheraton Grand Hotel, 1230 J. St., Sacramento, CA.
- October 21, 2004, 6:30 p.m., Sheraton Hotel, 401 E. 6th Ave., Anchorage, AK.
- October 26, 2004, 6 p.m., Best Western Hotel, 3253 N. Nimitz Hwy, Honolulu, HI.

Copies of the Draft PEIS will be made available for review at various libraries. A list of library locations and a downloadable electronic version of the Draft PEIS are available on the MDA public access Internet Web site: *http://www.acq.osd.mil/mda/peis/html/home.html.* To ensure all comments are addressed in the Final PEIS, comments should be received at one of the addressed listed below no later than November 17, 2004.

ADDRESSES: Written and oral comments regarding the Draft PEIS should be directed to MDA BMDS PEIS, c/o ICF Consulting, 9300 Lee Highway, Fairfax, VA 22031, phone (Toll-Free) 1–877–MDA–PEIS (1–877–632–7347), Fax (Toll-Free) 1–877–851–5451, e-mail *mda.bmds.peis@icfconsulting.com*, or Web site *http://www.acq.osd.mil/mda/peis/html/home.html.*

FOR FURTHER INFORMATION CONTACT: Please call Mr. Rick Lehner, MDA Director of Communications at (703) 697–8997.

SUPPLEMENTARY INFORMATION: The MDA has a requirement to develop, test, deploy, and prepare for decommissioning the BMDS to protect the United States (U.S.), its deployed forces, friends, and allies from ballistic missile threats. The proposed action would provide an integrated BMDS using existing infrastructure and capabilities, when feasible, as well as emerging and new technologies, to meet current and evolving threats in support of the MDA's mission. Conceptually, the BMDS would be a layered system of weapons, sensors, Command and Control, Battle Management, and Communications (C2BMC), and support assets; each with specific functional capabilities, working together to defend against all classes and ranges of threat ballistic missiles in all phases of flight. Multiple defensive weapons would be used to create a layered defense comprised of multiple intercept opportunities along the incoming threat missile's trajectory. This would provide

a layered defense system of capabilities designed to back up one another.

This Draft PEIS considers two alternative approaches for implementing the integrated BMDS. In Alternative 1, the MDA would develop, test, deploy, and plan to decommission land-, sea-, and air-based platforms for BMDS weapons components and related architecture and assets. The BMDS envisioned in Alternative 1 would include space-based sensors but would not include space-based weapons. In Alternative 2, the MDA would develop, test, deploy, and plan to decommission land-, sea-, air-, and space-based platforms for weapons and related architecture and assets. Alternative 2 would be identical to Alternative 1, with the addition of space-based defensive weapons.

Under the No Action Alternative, the MDA would not test, develop, deploy, or plan for decommissioning activities to implement an integrated BMDS. Instead, the MDA would continue existing test and development of discrete missile defensive systems as stand-alone defensive capabilities. Under the No Action Alternative, individual components would continue to be tested to determine the adequacy of their stand-alone capabilities, but would not be subjected to integrated system-wide tests. In addition, the C2BMC architecture would be designed around the needs of individual components and would not be designed to manage an integrated system.

The approach and methods for deployment and decommissioning of components under the No Action Alternative would be the same as under the proposed action. This alternative would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress to defend the U.S. against ballistic missile attack.

Potential impacts of Alternative 1 and Alternative 2 were analyzed in the Draft PEIS, including impacts to air quality, airspace, biological resources, geology and soils, hazardous materials and waste, health and safety, noise, transportation, orbital debris, and water resources. The impacts of the No Action Alternative would be the same as the impacts of developing and testing individual components, which would continue to comply with NEPA analyses and documentation requirements on a program-specific basis. Potential cumulative impacts of the proposed action are also addressed in the Draft PEIS.

Dated: September 10, 2004.

L.M. Bynum,

Alternate OSD Federal Register Liaison Officer, Department of Defense.

[FR Doc. 04–20813 Filed 9–16–04; 8:45 am]

BILLING CODE 5001–06–M

DEPARTMENT OF DEFENSE

Department of the Army

Department of Defense Historical Advisory Committee; Meeting

AGENCY: Department of the Army, DoD.

ACTION: Notice of open meeting.

SUMMARY: In accordance with section 10(a)(2) of the Federal Advisory Committee Act (Pub. L. 92–463), announcement is made of the following committee meeting:

Name of Committee: Department of Defense Historical Advisory Committee.

Date: October 28, 2004.

Time: 9 a.m. to 4:30 p.m.

Place: U.S. Army Center for Military History, Collins Hall, Building 35, 103 Third Avenue, Fort McNair, DC 20319–5058.

Proposed Agenda: Review and discussion of the status of historical activities in the United States Army.

FOR FURTHER INFORMATION CONTACT: Dr. Jeffrey J. Clarke, U.S. Army Center of Military History, ATTN: DAMH–ZC, 103 Third Avenue, Fort McNair, DC 20319–5058; telephone number (202) 685–2709.

SUPPLEMENTARY INFORMATION: The committee will review the Army's historical activities for FY 2004 and those projected for FY 2005 based upon reports and manuscripts received throughout the period. And the committee will formulate recommendations through the Chief of Military History to the Chief of Staff, Army, and the Secretary of the Army for advancing the use of history in the U.S. Army.

The meeting of the advisory committee is open to the public. Because of the restricted meeting space, however, attendance may be limited to those persons who have notified the Advisory Committee Management Office in writing at least five days prior to the meeting of their intention to attend the October 28, 2004 meeting.

Any members of the public may file a written statement with the committee before, during, or after the meeting. To the extent that time permits, the committee chairman may allow public presentations or oral statements at the meeting.

Dated: August 19, 2004.

Jeffrey J. Clarke,

Chief Historian.

[FR Doc. 04–20956 Filed 9–16–04; 8:45 am]

BILLING CODE 3710–08–M

DEPARTMENT OF DEFENSE

Department of the Army

Availability of Non-Exclusive, Exclusive License or Partially Exclusive Licensing of U.S. Patent Concerning Collapsible and Portable Work Station

AGENCY: Department of the Army, DoD.

ACTION: Notice.

SUMMARY: In accordance with 37 CFR part 404.6, announcement is made of the availability for licensing of U.S. Patent No. US 6,776,105 B2 entitled "Collapsible and Portable Work Station" issued August 17, 2004. This patent has been assigned to the United States Government as represented by the Secretary of the Army.

FOR FURTHER INFORMATION CONTACT: Mr. Robert Rosenkrans at U.S. Army Soldier Systems Center, Kansas Street, Natick, MA 01760, Phone: (508) 233–4928 or E-mail: *Robert.Rosenkrans@natick.army.mil.*

SUPPLEMENTARY INFORMATION: Any licenses granted shall comply with 35 U.S.C. 209 and 37 CFR part 404.

Brenda S. Bowen,

Army Federal Reserve Liaison Officer.

[FR Doc. 04–20957 Filed 9–16–04; 8:45 am]

BILLING CODE 3710–08–M

DEPARTMENT OF DEFENSE

Department of the Army

Availability of Non-Exclusive, Exclusive License or Partially Exclusive Licensing of U.S. Patent Concerning Method for Making a Disposable Package for an Agent Activatable Substance and a Package Made Thereby

AGENCY: Department of the Army, DoD.

ACTION: Notice.

SUMMARY: In accordance with 37 CFR part 404.6, announcement is made of the availability for licensing of U.S. Patent No. US 6,766,797 B1 entitled "Method for Making a Disposable Package for an Agent Activatable Substance and a Package Made Thereby" issued July 27, 2004. This patent has been assigned to the United

A downloadable version of the Draft BMDS PEIS was available on the BMDS PEIS public information web site. The web site also provided information on the Draft BMDS PEIS, the NEPA process, contact information for submitting comments on the Draft PEIS, and links to documents incorporated by reference in the Draft PEIS.

The MDA established a toll-free phone line, toll-free fax, e-mail address, and mailbox for submittal of public comments and questions. In addition, the BMDS PEIS web site provided an electronic comment form for individuals to submit comments. The MDA also held four public hearings to solicit comments on the Draft BMDS PEIS. The public hearings were held in Arlington, Virginia, October 14, 2004; Sacramento, California, October 19, 2004; Anchorage, Alaska, October 21, 2004; Honolulu, Hawaii, October 26, 2004. The public hearings consisted of information poster sessions; formal presentations by MDA officials on the Draft BMDS PEIS; and a formal public comment session. A court reporter was present at each public hearing to document the proceedings and record public comments for the administrative record. Transcripts from each public hearing are included at the end of this appendix.

In addition to announcing the public hearing in the NOA, the MDA placed paid legal notices in local and regional publications. Exhibit B-11 summarizes the publications in which the public hearings were advertised, including publication dates.

Exhibit B-11. Local and Regional Publications and Dates for Public Hearing Announcements

Public Hearing Notification	Newspaper	Publication Date(s)
Arlington, VA	Journal Newspapers: Alexandria County, VA; Arlington Country, VA; Fairfax County, VA; Montgomery County, MD; Prince George's County, MD; Prince William County, VA	October 7, 2004 October 8, 2004
	Washington Times	October 11, 2004 October 12, 2004
Sacramento, CA	Sacramento Bee	October 13, 2004 October 16, 2004
	Lompoc Record	October 13, 2004 October 14, 2004 October 15, 2004
Anchorage, AK	Anchorage Daily News	October 13, 2004 October 16, 2004

Exhibit B-11. Local and Regional Publications and Dates for Public Hearing Announcements

Public Hearing Notification	Newspaper	Publication Date(s)
	Kodiak Daily Mirror	October 13, 2004 October 15, 2004
	Fairbanks Daily News Miner	October 13, 2004 October 16, 2004
Honolulu, HI	Honolulu Star-Bulletin	October 18, 2004 October 19, 2004
	Honolulu Advertiser	October 16, 2004 October 19, 2004
	Garden Island Newspaper, Kauai, HI	October 18, 2004 October 19, 2004
	The Environmental Notice (Office of Environmental Quality Control)	October 8, 2004

Release of the Draft PEIS Notification Letter

The MDA sent letters and a copy of the NOA to state governors, mayors, and members of Congress indicating the MDA's release of the Draft BMDS PEIS and dates of the public hearings. A copy of the Draft PEIS notification letter is shown in Exhibit B-12.

Exhibit B-12. Draft BMDS PEIS Notification Letter

DEPARTMENT OF DEFENSE
MISSILE DEFENSE AGENCY
7100 DEFENSE PENTAGON
WASHINGTON, DC 20301-7100

SEP 6 2007

The Honorable John Warner
Chairman
Committee on Armed Services
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

For many years the plan for our nation's missile defense systems was to develop, test, and deploy them as separate weapons systems. As stewards of our environmental resources, the Military Services and Federal Agencies such as the Strategic Defense Initiative Organization and the Ballistic Missile Defense Organization successfully completed dozens of environmental analyses to assess and mitigate the potential environmental impacts of these individual systems and to inform the public regarding those potential impacts, as required by the National Environmental Policy Act (NEPA). In January 2002, the Department of Defense created the Missile Defense Agency (MDA) to establish and carry out a single program of research and development work to develop an integrated Ballistic Missile Defense System (BMDS). Since that time, MDA has been and will continue to be a strong steward of our global environment and has completed numerous environmental analyses that have provided extensive details of potential environmental impacts as well as measures to mitigate any impacts which could be associated with BMDS elements' activities.

The MDA's primary mission is to plan and execute an evolutionary, capability-based acquisition approach to develop and deploy missile defense capabilities as soon as possible. Based on this evolutionary approach and following the spirit of the NEPA, MDA developed a Draft Programmatic Environmental Impact Statement (PEIS) to address the potential environmental effects associated with the development, testing, deployment, and planning for decommissioning of the BMDS. The BMDS would use existing infrastructure and capabilities, when feasible, to reduce costs and environmental impacts and to meet current and evolving threats from ballistic missiles. The Draft PEIS provides an overarching and comprehensive NEPA analysis of MDA's ongoing and planned activities and addresses the MDA requirement to develop and field an integrated BMDS capable of providing a layered defense for the United States, its deployed forces, friends, and allies from ballistic missile threats of all ranges in all phases of flight.

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The MDA plans to release the Draft PEIS for public review and comment later this month and will also hold public hearings in October 2004 to solicit public comment in accordance with the NEPA public involvement process. The enclosed Notice of Availability provides the dates and locations of the public hearings.

Please contact Ms. Pamelia Bain, MDA Director of Legislative Affairs, at (703) 695-8520, if you have questions regarding this matter. The document can be downloaded from MDA's web site at www.acq.osd.mil/mda/peis/html/home.html or obtained on CD-ROM by contacting Ms. Bain.

Sincerely,

Henry A. Obering III

HENRY A. OBERING III
Lieutenant General, USAF
Director

Enclosure:
As stated

cc:
The Honorable Carl Levin
Ranking Member

The MDA distributed CD-ROMs containing an electronic copy of the two-volume Draft BMDS PEIS to members of the public requesting a copy. A complete list of the Draft BMDS PEIS Distribution list is available in Section 7.0.

Comments Received on the Draft PEIS

The MDA received approximately 8,500 comments on the Draft PEIS during the public comment period. Summaries of comments and responses to comments are provided in Appendix K.

Public Hearing Transcripts

Exhibits B-13 through B-16 contain the transcripts from the four public hearings the MDA held on the Draft BMDS PEIS.

Exhibit B-13. Arlington, Virginia Public Hearing Transcripts

U.S. DEPARTMENT OF DEFENSE

MISSILE DEFENSE AGENCY

* * *

PUBLIC HEARING ON

DRAFT BALLISTIC MISSILE DEFENSE SYSTEM

PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

* * *

Thursday, October 14, 2004

7:00 p.m.

Potomac Ballroom
Crystal City Marriott
1999 Jefferson Davis Highway
Arlington, Virginia

I N D E X

P R O C E E D I N G S

MR. DUKE: I'd like to go ahead and get started. I'd like to welcome you all to tonight's meeting. This public hearing is for the Missile Defense Agency's Ballistic Missile Defense System Draft Programmatic Environmental Impact Statement.

This public hearing is being held in accordance with the National Environmental Policy Act, or NEPA. My name is Marty Duke and I am the Missile Defense Agency's Program Manager for the development of the Programmatic Environmental Impact Statement.

I would like to introduce Colonel Mark Graham, who is from the Missile Defense Agency's Office of General Counsel. Colonel Graham will talk about the Programmatic Environmental Impact Statement, the NEPA process, and the BMDS capabilities and components. Also, I would like to introduce Peter Bonner and Deb Shaver, who are with ICF Consulting. Ms. Shaver is the ICF Consulting Program Manager and technical lead for the PEIS, and Mr. Bonner will facilitate tonight's meeting.

Again, I would like to thank you all for coming out tonight, and now, I'd like to turn the meeting over to Peter, who will go over tonight's meeting agenda and

discuss some of the administrative points on how to provide public comments.

Thank you.

MR. BONNER: Good evening. I would also like to welcome you all to tonight's session. First, let's dispense with a few tongue twisters. We can't be in D.C. without some acronyms to start.

During this evening, as we move through the presentation, we will refer to the Missile Defense Agency as MDA. As we review it, we'll look at the Ballistic Missile Defense System--I've got to get it out myself here--which we'll refer to as BMDS, and the Programmatic Environmental Impact Statement as PEIS.

At this hearing we will discuss the development of MDA's Draft BMDS PEIS. After that, we will discuss the proposed action, which is the implementation of an integrated BMDS. The activities involved in implementing the BMDS have been analyzed for their potential environmental impact.

Finally, we will provide a forum to collect public comments on the Draft PEIS. It is our goal to have an open and informative public process.

Let's talk about the agenda for this evening. To ensure MDA has sufficient time to receive oral comments

this evening, we will spend the next 30 to 40 minutes presenting information about the BMDS, the NEPA process and our analysis in producing the draft PEIS. The presentation will discuss the following: What is a programmatic EIS? What is the BMDS? How were potential impacts analyzed in the BMDS PEIS? And how does one submit public comments for the draft PEIS? What are the results of the analysis?

After the presentation, we'll have a 15-minute break when any of you who want to make public comments will have an opportunity to go back and sign up for those. I see some of you have already done that at the registration table. After the break, each speaker will be called in the order they signed up to come up and make their statements. Following the public statements MDA representatives will be available in the poster area to answer questions and have discussions. Note that questions and discussions back in the poster area during that 15-minute break or after the session will not be recorded for public comment. All the questions can be formally submitted to MDA through one of the other available methods.

The most important aspect of tonight's meeting is your public comments, and we want to hear from you.

All public statements provided tonight will be recorded for a transcript. Remember that the Programmatic EIS is just a draft document. This is your opportunity to provide comments on that document before it is finalized and before a final decision is made.

We are here to listen firsthand to your suggestions and concerns. Please limit your comments to five minutes to give everyone an opportunity to speak. I don't think we're going to have a big problem with that this evening.

The purpose of this meeting is to gather your comments. We will attempt to answer your questions clarifying the points we make in the presentation tonight. Substantive questions recorded tonight will be carefully considered in the preparation of the Final PEIS.

If you wish to provide written comments, forms are available at the registration table. You may leave written comments with us at the registration table or you can mail them to us. You can email them. The email system is temporarily unavailable right now, or you can fax them to MDA using the information provided. To allow time to consider and respond to comments in the Final PEIS, all comments must be received no later than November 17.

Colonel Graham will now discuss the BMDS PEIS and the NEPA process. Colonel Graham?

COLONEL GRAHAM: Thank you, Peter.

Good evening. NEPA Analysis NEPA establishes our broad national framework for protecting the environment. NEPA requires Federal agencies to consider the environmental impacts of their proposed actions and reasonable alternatives to those actions early in the decision-making process. The NEPA process is intended to help public officials make decisions based on understanding environmental consequences and take actions that protect, restore, and enhance the environment.

In the past, the national approach to missile defense focused on the development of individual missile defense elements or programs, such as Patriot, the Airborne Laser, and ground-based interceptors. These actions were appropriately addressed in separate NEPA analyses that MDA, its predecessor agencies, and executing agents prepared for these systems.

The aim of missile defense has been refocused by the Secretary of Defense to develop an integrated Ballistic Missile Defense System that would be a layered system of components working together capable of defending

against all classes and ranges of threat ballistic missiles in all phases of flight.

Because the integrated Ballistic Missile Defense System is a large program made up of many projects implemented over time on a worldwide basis, MDA has determined that a programmatic NEPA analysis would be appropriate. Therefore, the MDA has prepared a Programmatic EIS to analyze the environmental impacts of implementing the proposed program.

A Programmatic EIS, or a PEIS, analyzes the broad envelope of environmental consequences in a wide-ranging Federal program like the Ballistic Missile Defense System. A PEIS looks at the overall issues in a proposed program and considers related actions together to review the program comprehensively. A PEIS is appropriate for projects that are broad in scope, are implemented in phases, and are widely dispersed geographically.

A PEIS creates a comprehensive, global analytical framework that supports subsequent analysis of specific activities at specific locations, which could then be tiered from the PEIS. The Programmatic EIS is intended to serve as a tiering document for subsequent specific Ballistic Missile Defense System analyses and

includes a road map for considering impacts and resources areas in developing future documents.

This road map identifies how a specific resource area can be analyzed and also includes thresholds for considering the significance of environmental impacts to specific resource areas. This means that ranges, installations, and facilities at which specific program activities may occur in the future could tier their documents from the PEIS and have some reference point from which to start their site-specific analysis.

The Ballistic Missile Defense System Programmatic EIS analyzes the potential environmental impacts of developing, testing, deploying, and planning for decommissioning for the proposed program. The Programmatic EIS evaluates proposed Ballistic Missile Defense System technology, components, assets, and programs and considers future development and application of new technologies.

The proposed action considered in the BMDS Programmatic EIS is for the MDA to develop, test, deploy, and to plan for decommissioning activities for an integrated Ballistic Missile Defense System using existing infrastructure and capabilities, when feasible, as well as

emerging and new technologies, to meet current and evolving threats.

When feasible, the MDA would use existing infrastructure to implement the BMDS and would incorporate new technologies and capabilities as they become available. This would ensure that the program could provide defense for both current and future ballistic missile threats.

The purpose of the proposed action is to incrementally develop and deploy a Ballistic Missile Defense System, the performance of which can be improved over time, and that layers defenses to intercept ballistic missiles of all ranges in all phases of flight. The proposed action is needed to protect the United States, its deployed forces, friends, and allies from threat ballistic missile [sic].

In this Programmatic EIS, the MDA considers two alternative approaches to implementing the BMDS system in addition to the No Action Alternative. The alternative approaches address the use of weapons components from land-, sea-, air-, and space-based platforms.

Alternative One is to develop, test, deploy, and plan to decommission an integrated Ballistic Missile Defense System that includes land-, sea-, and air-based

weapons platforms. The BMDS envisioned in Alternative One would include space-based sensors, but would not include space-based defensive weapons.

Alternative Two is to develop, test, deploy, and plan to decommission an integrated Ballistic Missile Defense System that includes land-, air-, sea-, and space-based weapons platforms. Alternative Two would be identical to Alternative 1, with the addition of space-based defensive weapons.

The Council on Environmental Quality regulations implementing NEPA also require the consideration of the No Action Alternative. Under the No Action Alternative, the MDA would not develop, test, deploy or plan for decommissioning activities for an integrated Ballistic Missile Defense System. Please note that under the No Action Alternative, MDA would continue existing development and testing of individual elements as stand-alone defensive capabilities. Individual systems would continue to be tested but would not be subjected to system integration tests.

Alternatives One and Two provide different weapons platforms options for implementing an integrated Ballistic Missile Defense System, while the No Action Alternative continues the traditional approach of

developing individual missile defense elements, such as the Airborne Laser, Patriot, and ground-based interceptors.

I will now discuss how MDA categorized the Ballistic Missile Defense System into relevant components and life cycle activities that could be considered to provide the programmatic overview of the environmental impacts of implementing the proposed action.

MDA's goal in developing an integrated Ballistic Missile Defense System is to develop an integrated system that will provide a layered defense. The Ballistic Missile Defense System would be capable of destroying threat ballistic missiles in the boost, mid-course, and terminal phases of flight and would defend against short, medium, intermediate and long-range threat ballistic missiles.

Finally, the Ballistic Missile Defense System would integrate sensors and weapons through a command control, battle management, and communications network, which we call C2BMC. With this capability, the integrated Ballistic Missile Defense System would establish a defense against the threat of ballistic missiles.

The BMDS is a complex system of systems. To be able to perform a meaningful impact analysis, we

considered the Ballistic Missile Defense System in terms of its components: weapons, sensors, C2BMC, and support assets. These components are the building blocks that can be assembled with specific functional capabilities and can be operated together or independently to defeat threat ballistic missiles.

Testing was considered for each component; however, the integrated Ballistic Missile Defense System needs to be tested at the system level and was analyzed separately using realistic system integration flight test scenarios. Let's look at each of these components.

Weapons: the Ballistic Missile Defense System weapons would provide defense against threat ballistic missiles. They include interceptors and directed energy weapons in the form of high-energy lasers that would be used to negate threat missiles. Interceptors would use hit-to-kill technology, either through direct impact or directed fragmentation. The Ballistic Missile Defense System weapons are designed to intercept threat ballistic missiles in one or more phases of flight and could be activated from land, sea-, air-, or space-based platforms.

The Ballistic Missile Defense System sensors would provide the relevant tracking data for threat ballistic missiles. Sensors detect and track threat

missiles; and assess whether a threat has been destroyed. Sensors provide the information needed to locate and track a threat missile to support coordinated and effective decision-making against the threat.

There are four basic categories of sensors considered for the Ballistic Missile Defense System: we have radars, infrared, optical, and laser sensors. Radars send a signal out and detect the same signal as it bounces off an object. Infrared sensors are passive sensors that detect and track heat or infrared radiation from an object. Optical sensors are passive sensors, too, that collect light energy or radiation emitted from an object, and laser sensors use laser energy to illuminate and detect the object's motion.

Radars and lasers emit radiation while infrared and optical sensors detect radiation that has been emitted. The Ballistic Missile Defense System sensors would operate from multiple platforms, such as land, sea, air, or space.

The data collected by the Ballistic Missile Defense System sensors would travel through the communication system to command and control where a battle management decision on whether to use a defensive weapon would be made. The C2BMC would integrate and coordinate

equipment and operators through command and control and integrated fire control centers. C2BMC would enable military commanders to receive and process information, make decisions, and communicate those decisions regarding the engagement of threat missiles.

The C2BMC would include fiber optic cable, computer terminals, and antennas and would operate from land-, sea-, air-, and space-based platforms.

Our last category of components is support assets. Support assets would be used to facilitate development, testing, and deployment of Ballistic Missile Defense System components. Support assets are one of three types: support equipment, infrastructure, or test assets. Support equipment includes general transportation and portable equipment such as automobiles, ships, aircraft, rail, and generators. Infrastructure includes docks, shipyards, launch facilities, airports and air stations. Test assets include test range facilities, targets, countermeasure devices, simulants, and observation vehicles.

Now that we've discussed the components, Mr. Marty Duke will describe how they can be integrated into the Ballistic Missile Defense System.

MR. DUKE: This slide depicts the integration of the various components of the proposed BMDS we have just discussed. The use of multiple defensive weapons and sensors operating from a variety of platforms integrated through a single C2BMC system would create a layered defense allowing several opportunities to intercept and destroy threat missiles.

For example, one weapon could engage a threat missile in its boost phase, and another could be used to intercept the threat missile in later phases if initial intercept attempts were unsuccessful.

Components are incorporated into the BMDS through the life cycle phases of the system acquisition process. These life cycle phases are development, testing, deployment, and decommissioning. New components would undergo initial development testing, while existing components would be tested to determine their readiness for use. Work on a given technology would stop if testing failed to demonstrate effectiveness or if functional capability needs changed.

Components and elements would be deployed as testing demonstrates that they are sufficiently capable of defending against threat ballistic missiles. In most cases, a component would be deployed when testing

demonstrates that it is capable of operating within the integrated BMDS and the associated safety and health procedures are developed and adequate. This process concludes with decommissioning, which would occur when and where appropriate.

To determine the environmental impacts, this PEIS analyzes the proposed BMDS components by considering the various life cycle phase activities of each component as well as the operating environments in which the activities are taking place. This slide tries to depict the multi-dimensional complexities involved in considering the impacts of implementing an integrated BMDS in terms of its components, acquisition life cycle phases, and operating environments.

Because of the complex nature of the project, an analysis strategy was developed to effectively yet efficiently consider the broad range of environmental impacts from the proposed BMDS. First, the existing condition of the affected environment was characterized for the locations where various BMDS activities are proposed to occur. Next, MDA determined the resource areas that could potentially be affected by implementing the proposed BMDS. Finally, impacts of the BMDS were analyzed in four steps.

In step 1, we identified and characterized life cycle phase activities. In step 2, we identified activities with no potential for impact and dismissed them from further analysis. In Step 3, we identified similar activities across life cycle phases and combined them for analysis. And in Step 4, we conducted the impacts analysis for all remaining activities. The first three steps were used to categorize and reduce the number of unique life cycle activities thereby reducing the redundancy in preparing the impacts analysis.

The affected environment includes all land, air, water, and space environments where proposed BMDS activities are reasonably foreseeable. The affected environments have been considered in terms of the broad ocean area, the atmosphere, and nine terrestrial biomes. A biome is a geographic area with similar environments or ecologies. Climate, geography, geology, and distribution of vegetation and wildlife determine the distribution of the biomes. These biomes encompass both U.S. and non-U.S. locations where the BMDS could be located or operated.

The resource areas considered in this analysis are those resources that can potentially be affected by implementing the proposed BMDS. NEPA analyses generally consider the resource areas listed on the screen, except

for orbital debris. Because missile defense development and test activities include the launch and intercept of missiles, space-based communications and other satellites, and potential for space-based interceptors, MDA considered orbital debris and its impacts on the Earth.

The PEIS discusses all resource areas, provides a methodology for analysis, and suggests thresholds of significance to provide the reader with a roadmap for performing future site-specific analyses tiering from this PEIS. These discussions outline the type of information that would be needed to conduct site-specific analyses and identify the steps necessary to ensure that potential impacts are appropriately considered.

The resource areas, highlighted on the slide with a red star, require site-specific information for analysis and are those more effectively addressed in subsequent tiered analyses for specific activities.

Once we decided to consider the affected environment and the resource areas of concern, we used the four-step process I mentioned earlier. I will discuss each step in more detail. In step 1 of the impacts analysis, MDA identified and characterized the activities associated with each BMDS component. Each life cycle phase has activities applied to each component. For

example, development can include planning, research, systems engineering, and site preparation and construction. Testing can include manufacturing, site preparation and construction, transportation, activation, and launch activities. Deployment can include manufacturing, site preparation and construction, transportation, activation, launch, operation and maintenance, upgrades, and training. And finally, decommissioning includes demilitarization and disposal.

Once life cycle activities were identified, it was determined that some of those activities had no potential for impact. Activities such as planning and budgeting, systems engineering, and tabletop exercises are generally categorically excluded in various Department of Defense NEPA regulations and therefore were not further analyzed in this PEIS.

Other activities for specific components, such as transportation, maintenance and sustainment, and manufacturing, were not analyzed in this PEIS, because they have been evaluated in previous NEPA analyses and were found to have no significant environmental impacts.

The remaining activities were then examined to determine which activities had similar environmental impacts. For example, impacts associated with site

preparation and construction in the development phase would be similar to or the same as impacts from site preparation and construction activities in the deployment phase. Under step 3, similar activities occurring in different life cycle phases were identified and considered together to reduce redundancy.

The final step was to determine the impact associated with each remaining activity under the proposed action. The significance of an impact is a function of the nature of the receiving environment and the receptors in that environment. For example, an interceptor launch creates the same emissions no matter where it is launched. Whether those emissions cause impacts and the significance of those impacts depend upon the environment into which they are released.

The PEIS analyzes these emissions by component for each resource area and life cycle activity where a potential for impact was identified. Impacts were distinguished based on the different operating environments, land, sea, air, and space. The analysis also considered specific impacts for individual biomes where activities could occur. The impacts of system integration testing were considered separately from the impacts of individual BMDS component testing because

integration testing would involve using multiple components in the same test.

To deal effectively with integration testing, MDA looked at two generic system integration flight test scenarios which involved different numbers of launches and intercepts.

The impacts analysis for Alternative One considers the use of land-, sea-, and air-based platforms for BMDS weapons. The analysis includes the use of space-based sensors but not space-based weapons. The analysis is specific for each resource area based on the impacts from the activities associated with the BMDS component.

The impacts analysis for Alternative Two includes the use of interceptors from land-, sea-, air-, and space-based platforms for the BMDS weapons. The impacts associated with the use of interceptors from land, sea, and air platforms would be the same as those discussed for Alternative One; therefore, the analysis in Alternative Two focuses on the impacts of using interceptors from space-based platforms.

The fundamental difference between Alternative One and Two is that Alternative Two includes the analysis of space-based platforms for interceptors.

The cumulative impacts of implementing the BMDS were also considered. Cumulative impacts are defined as impacts that result from the incremental impacts of the proposed action when added to other past, present, and reasonably foreseeable future actions. Because this proposed action is worldwide in scope and potential application, only activities similar in scope have been considered for cumulative impacts.

Under Alterative One, worldwide launch programs for commercial and government programs were determined to be activities of similar scope. Therefore, the impacts of the BMDS launches were considered cumulatively with the impacts from other worldwide government and commercial launches.

Alternative Two includes placing defensive interceptors in space, which involves adding additional structures to space for extended periods of time.

The International Space Station was determined to be an action that is international in scope and has a purpose of placing structures in space for extended periods of time. Therefore, the impacts of the use of space-based weapons platforms were considered cumulatively with the impacts of the International Space Station.

The next few slides provide broad summaries of the impacts analysis by BMDS component and Test Integration for Alternatives One and Two, the No Action Alternative, and the cumulative impacts for Alternatives One and Two. Please note that the results are extremely high level suitable for a brief presentation. Additional details have been provided in some of the posters that you see behind us. The impacts analysis may also be found in the Executive Summary impact tables and in Section 4 of the Draft PEIS.

It is important to note that no environmental showstoppers were found in this programmatic impact analysis. As the next few slides show, there are potential impacts associated with the various activities needed to implement the BMDS; however, they would be appropriately addressed in subsequent tiered NEPA analyses with mitigation actions as required to ensure less than significant impacts.

This slide shows a summary of the broad potential for environmental impacts associated with BMDS weapons activities as examined for each resource area for Alternatives One and Two. Again, please note that this is a very high-level depiction of the results of the analysis, and additional details of the weapons analysis

may be found in the tables in the Executive Summary of the Draft PEIS. However, one can see from these slides general activities and resource areas that should be considered in subsequent tiered NEPA analyses.

This slide shows the impacts summary for the BMDS sensors. Note that the impacts are the same for Alternatives One and Two and include space-based sensor platforms. This summary also shows how MDA categorization of activities helped to simplify the analysis.

For example, the activation of radars would not impact air quality because the only emissions resulting from radars would be from supporting diesel generators, which are addressed under support assets. However, radars generate electromagnetic radiation; which could potentially impact biological resources.

Although C2BMC is the glue that enables the integrated BMDS to function effectively as a system, this component creates little potential for environmental impacts.

Impacts associated with Support Assets are mainly those that would be caused by site preparation and construction of infrastructure and by using test assets such as countermeasures and simulants during testing.

Test integration overall has the most potential for impacts, because it includes the use of several components during increasingly realistic test scenarios. Although this programmatic analysis showed the potential for impacts, the existing environment at the proposed test location and the specific test activities planned will determine the nature and extent of the impacts.

The No Action Alternative would continue the development and testing of individual weapons, sensors, C2BMC, and support assets and would not include integration testing of these components. The environmental impacts of the No Action Alternative would be the same as the impacts resulting from continued development and testing of individual missile defense elements.

The decision not to deploy a fully integrated BMDS could result in the inability to respond to a ballistic missile attack on the U.S. or its deployed forces, allies, or friends in a timely and successful manner. Further, this alternative would not meet the purpose or need of the proposed action or the specified direction of the President and the U.S. Congress.

We examined the impact of worldwide launches for cumulative impacts. Launches can create cumulative

impacts by contributing to global warming and ozone depletion. Potential launch emissions that could affect global warming include carbon monoxide and carbon dioxide, or CO_2. Unlike CO_2, carbon monoxide is not a greenhouse gas; but, it can contribute indirectly to greenhouse gas effects.

The cumulative impacts on global warming of emissions from BMDS launches would be insignificant compared to emissions from other industrial sources, such as energy generation. The BMDS launch emissions load of CO_2 and carbon monoxide would only be five percent of the emissions load from worldwide launches. In addition, CO_2 and carbon monoxide from 10 years of BMDS and worldwide launches combined would account for much less than one percent of CO_2 and carbon monoxide emissions from U.S. industrial sources in a single year.

Chlorine is of primary concern with respect to ozone depletion. Launches are one of the man-made sources of chlorine in the stratosphere. The cumulative impacts on stratospheric ozone depletion from launches would be far below the effect caused by other natural and man-made sources. The emission load of chlorine from both BMDS and other launches worldwide occurring between 2004 and 2014 would account for about half of one percent of the

industrial chlorine load just from the U.S. in a single year.

The orbital debris produced by BMDS activities would generally be small and would consist primarily of launch vehicle hardware, old satellites, bolts, and paint chips. It may also be possible for debris from an intercept to become orbital debris. However, orbital debris produced by BMDS activities would occur in low-earth orbit, where debris would gradually drop into successively lower orbits and eventually reenter the atmosphere.

Therefore, orbital debris from BMDS activities would not pose a long-term hazard to the International Space Station or other orbiting structures. In addition, collision avoidance measures would further reduce the potential for orbiting debris to damage orbiting structures such as the International Space Station.

I would like to reiterate that our impact analysis indicated no showstoppers or expected areas of significant impact. However, many resource areas showed potential for impacts, indicating that these areas need to be considered in subsequent analysis tiered from this PEIS.

Now, I would like to turn the meeting over to Peter Bonner.

MR. BONNER: Okay; now that we've looked at the proposed BMDS and the potential impacts from its implementation, let's talk about the PEIS schedule. The Notice of Intent was released in April of 2003 in the Federal Register and published in the Federal Register on April 11. The MDA released the Draft PEIS just this past September. The public comment period on the draft, which is currently underway, will continue through November 17. After that, the MDA will consider all comments received and incorporate the appropriate changes in the PEIS.

The release of the Final PEIS to the public will be in December 2004 or January 2005. After that, there will be a 30-day waiting period before the MDA can issue its final Record of Decision, or ROD.

Let me turn to submitting comments on the draft PEIS, including your comments tonight. You can provide your comments either orally or in writing. The oral or written comments will be given equal consideration in preparing the Final PEIS. If you would like to make a public statement at tonight's meeting, please sign up at the registration table. Each speaker will be given five minutes, as I said before.

The public statements by tonight's speakers will be recorded by the court reporter to ensure that we accurately get all of your comments for the Draft PEIS. There is also a toll-free telephone number for you to submit comments, and please refer to your handouts for that toll-free telephone number.

You can also submit your comments in writing to us. There are four ways to do that. One is if you have your comments tonight, give them to us, and we'll record them in the Draft PEIS for consideration. Use the comment forms provided and submit them tonight; fax or email your comments. The email system, as I said before, is temporarily unavailable right now but will be back up; or use the electronic comment form provided on the MDA BMDS PEIS Website.

The information on the screen lists the various ways you can do this. The information is also listed on the comment forms at the registration table. For additional information, please visit the Website. There's lots of information on there. It provides descriptions of the topic areas talked about this evening as well as links for obtaining some additional information.

We encourage you to sign up to receive a hard copy of the Executive Summary of the final PEIS and a CD-

ROM containing the entire document of the PEIS when it becomes available. Signing up for that is also available at the registration table.

The Final PEIS will also be available in PDF format to be downloaded from the BMDS PEIS web site, and hard copies will be in local libraries. A list of these libraries is also available on the BMDS PEIS web site, and we've got the URL for the Website right there.

Marty?

MR. DUKE: Yes, I just want to remind everyone that no decision on this project is going to be made tonight. We are here to listen to your concerns both oral and written, so as we finalize the draft, that we know what your concerns are and can address those in the final PEIS.

Again, the final comments, please, we need to have them submitted by November 17, 2004, and at this point, I'd like to take a 15-minute break to set up for the public statements. Again, please take this time, if you haven't had the opportunity, to sign up at the table. Thank you, and we look forward to your comments.

MR. BONNER: Okay; please take your seats. Let's get started. I have the list of registered speakers. I will call each person to the front of the

room to speak. Please limit your comments to five minutes. At four minutes, I will hold up my expertly made sign.

[Laughter.]

MR. BONNER: That you've got one minute left.

If you have a written version of your oral comments, we ask that you provide it so that we can keep a record of that statement. When providing your public statements, please remember to state your name and your affiliation and speak clearly and distinctly for the meeting recorder.

If you do not wish to give an oral or public statement here tonight, please consider providing your comments through one of the other available methods that we talked about earlier. We're seeking an open process and have tried to develop many avenues for you to provide input to that process.

Is Victoria Samson here? Victoria, if you'd come up to the microphone.

MS. SAMSON: Hi. Thank you. My name is Victoria Samson. I'm with the Center for Defense Information

The draft Ballistic Missile Defense Programmatic Environmental Impact Statement, dated September 1, 2004,

is supposed to give an objective and thorough assessment of the effects various missile defense architectures would have on the environment. However, it has obviously been shaped to give credibility to the Bush administration's continued assertions that the only way the United States can be protected from an ICBM attack is with a heavily tiered system.

The draft PEIS dismisses any real concerns about harmful negative consequences from developing such a system and, in doing so, invalidates itself and its conclusions. To begin with, the so-called No-Action Alternative examined in this document is misleadingly named. It does not detail a scenario where no action is taken. Rather, it describes a system where the MDA would continue existing development and testing of discrete systems as stand-alone missile defense capabilities. Individual systems would continue to be tested but would not be subjected to system integration tests.

This is hardly no action, and it allows for an indeterminate amount of missile defense development, since there are currently no final or fixed architectures and no set operational requirements for the proposed BMDS. The way this draft PEIS is structured, even if MDA was limited

to the No-Action Alternative, it would not find its actions very much constrained.

Alternative Two, which includes the usage of space-based interceptors or SBIs, is questionable for many reasons. It looks at the effect of using SBIs in lieu of terrestrial-based ones; however, the BMDS that is repeatedly envisioned by MDA and Pentagon officials is one where targets would be engaged at all stages in their flight, from all types of launch platforms.

To look only at the usage of a single SBI is to willfully ignore the concept of operations that has been used to justify this massive defense system. The American Physical Society, in its boost-phase intercept study released in July 2003, estimated that a constellation of at least 1,000 SBIs would be required to provide a minimal defense against liquid-fueled ICBMs.

Granted, testing would be of a much lesser nature than a complete constellation, but at some point presumably the system would be tested at some fraction of its full strength. This draft PEIS does not take into consideration that possibility.

This draft PEIS also does not look at what would be required to develop a space-based test bed, dismissing the concept as being too speculative to be analyzed in

this PEIS. It does not say when such a concept would be analyzed. Finally, this document admits if Alternative Two were selected, additional environmental analysis could be needed as the technologies intended to be used became more defined and robust.

But again, that is what this document is supposed to do: examine the environmental effects of the proposed action. By sweeping it under the nebulous responsibility of future studies, it relieves the MDA of liability of negative consequences stemming from SBIs.

The draft PEIS fails to fully address the effects of debris, not just orbital but rocket fragments, fuel and so forth. It scratches the surface barely of potential harmful consequences that could plausibly result from the alternatives listed, and it immediately dismisses the few consequences that are divulged. Debris that could fall into the ocean would become diluted and would cease to be of concern. Debris that survived reentry is not to be worried about, as it would fall into a preestablished footprint.

Even if it didn't, debris is more likely to terminate in water than on land, because water covers 75 percent of the Earth's surface. Debris from spills or

intercepts in the air is assumed to dissipate before it hits the ground.

Yet this is making a real leap of faith in how these actions would affect the environment, and doing so in a manner that precludes any real assessment of what sort of consequences could occur. The treatment of the Airborne Laser, or ABL, is indicative of this attitude. The draft PEIS says that should the ABL not be able to land at an appropriate location, its fuel and laser chemicals may have to be jettisoned, but this would be at a minimum altitude of 15,000 feet and thus would be diluted in the atmosphere.

And if there was an accidental fire on the ABL, the liquid and solid laser chemicals would be consumed or contained. These laser chemicals include hydrogen peroxide, ammonia, chlorine, helium, and iodine, according to the document. No explanation is given as to what would happen should the ABL jettison its chemicals at a lower altitude than 15,000 feet, nor how exactly the fire would contain all chemicals. The draft PEIS makes these reassuring statements with no solid evidence to back them up.

Finally, the alternatives considered but not carried forward are deliberately chosen to showcase the

BMDS system that the Bush administration has been pushing for in the best light possible. The first one is to cancel development of BMDS capabilities, which is explained as being an alternative that would rely upon diplomatic and military measures to deter missile threats against the U.S. This is exactly what has kept the United States safe from attack to date, and yet it is summarily dismissed out of hand.

The other alternative is to focus on a single- or two-platform BMDS. But, per MDA threat assessments that are not given but merely referred to, it has decided that an effective missile defense should include components based on at least the land, sea, and air, so a more limited missile defense system simply would not do.

This draft PEIS does not fully examine the actual consequences that could very well result from developing and testing a tiered missile defense system. By deliberately rejecting any and all negative effects, it goes against what is legally required of the NEPA process.

Thank you.

MR. BONNER: Thank you.

Theresa Hitchens?

MS. HITCHENS: I'm a lot shorter than her. I'm Theresa Hitchens. I'm also from the Center for Defense

Information, and my comments are related to the treatment by the BMDS PEIS of the potential threats of space debris to objects and people in space, in the air and on the ground presented by the testing of ground-based and especially space-based interceptors.

The overall assumption of the PEIS is that there is a low-level risk from either orbital debris or debris reentering the Earth's atmosphere, and that is not supportable, due in large part to the failure of the MDA to undertake and provide adequate scientific review of the physics involved in debris creation and reentry from the multiple possible scenarios for missile defense intercepts.

Space debris is a major hazard to spacecraft and satellites because of the high impact velocities generated in orbit, meaning that even tiny pieces of debris, which you mention, such as bolts can damage or destroy an on-orbit asset. Reentry of space-based objects, such as the SBIs, can also threaten people or objects on the ground, as not all debris is burned up on its way through the atmosphere.

Major inadequacies in the PEIS treatment of issues related to debris include: Number one: the PEIS severely understates the potential threats to satellites

and spacecraft, as well as to people and objects on the ground, from orbital debris caused by ground-based midcourse interceptor tests. The PEIS fails to support its claim that little debris would be created because of lack of adequate modeling of likely debris creation from realistic testing of the ground-based interceptor, which would involve higher speed impacts at higher altitudes than testing so far.

Under realistic testing of GBIs, ground-based interceptors, there is a significant chance that debris could be created that would last for years, not simply the months as asserted by the PEIS.

Further, even short-term debris could be a danger to space objects such as the International Space Station, as the PEIS admits. And while the PEIS states that the ISS could be moved to avoid a collision with any large debris, it fails to recognize that other objects in low Earth orbit that might be threatened are not maneuverable.

Finally, the PEIS asserts that most of the debris created in low Earth orbit would be small and thus not a major hazard to the ISS. Unfortunately, as I said, even tiny pieces of debris could destroy the ISS or other space assets. In actuality, small debris is considered by

space operators as a bigger hazard to space objects because it cannot be detected and tracked adequately enough to allow planning for evasive maneuvers by those space objects that can do so. In other words, smaller debris could be a bigger threat to the ISS and other craft than larger pieces on orbit, and the PEIS undertakes no review of this fact of physics.

That said, the PEIS does not provide adequate scientific review to support the assertion that most debris would be small, a term that is undefined in the PEIS, raising the question of the risks from reentry into the atmosphere of both the interceptor and its target after an impact. Not all debris reentering the atmosphere burns up, as the PEIS suggests.

In January 1997, a Delta Two rocket second stage came down over Georgetown, Texas, with large pieces making landfall including a 580-pound stainless-steel fuel tank that landed 50 yards from a house. Another Delta Two second stage reentered the atmosphere over Cape Town, South Africa in April 2000, similarly raining large pieces of debris to the ground. It is important to note that a Delta Two second stage is considerably smaller than the either a ground-based midcourse interceptor or a target ICBM. It also is highly difficult to predict reentry

trajectories even from scripted test events because debris can, as the PEIS admits, skip off the atmosphere and land miles away from its original reentry point, and the PEIS provides no evidence that MDA made any significant effort to undertake the complex computer modeling required to predict such possible reentry scenarios.

Number Two: The PEIS fails to support its claim that there would be no significant impact to spacecraft and satellites, and objects and people on the ground, from the testing and deployment of Space-Based Interceptors. Given the inadequate articulation by MDA of the SBI concept itself, it is impossible for the MDA to make any claims about the risks to space objects from SBIs. Debris creation depends on a number of specific factors about individual impacts, such as the mass of the two objects impacting, their relative velocities at impact, the angle of impact, and altitude.

Since the MDA has yet to determine nor to provide in this PEIS critical design parameters of the SBIs themselves--their size, mass, and their speed--and the architecture of an SBI network, how many interceptors on orbit at what altitude--it is simply impossible for the MDA to support the PEIS claim that there is little debris risk, much less to support the PEIS suggestion that a

space-based architecture would present less risk to the environment than a solely ground-based one.

Without any specific parameters for an SBI network available, the MDA has no data for undertaking the necessary calculations to support its claims.

Last of all, the PEIS also neglects a critical factor regarding the potential for debris creation from SBIs: that is, the fact that any architecture means large numbers of missiles filled with highly volatile rocket fuel would be orbiting in LEO at altitudes where they themselves will be constantly bombarded by space debris, with an attendant risk of explosion caused by debris impact. The PEIS ignores this risk altogether.

In sum, the PEIS fails to support its conclusions about the risk from the creation of orbital debris and its possible reentry into the atmosphere due to a lack of adequate and complete scientific review. Thus, the PEIS itself is fatally flawed and not legally acceptable.

Thank you.

MR. BONNER: Thank you for your input and comments.

Stephan Young?

MR. YOUNG: My name is Stephan Young. I'm a senior analyst at the Union of Concerned Scientists. I have a number of concerns about this PEIS and the proposed deployment of a missile defense system.

First, it seems clear to me that the NEPA laws are not being fulfilled as required by law.

This study is being done, for large parts of the program, after the fact. As the PEIS says, it, quote, evaluates the potential environmental impacts of activities associated with the development, testing, deployment and planning for decommissioning of the BMDS.

For example, for the ground-based missile defense system, many of those stages are already complete. The silos have been built, the interceptors have been built, many of the tests have been conducted, and the radars have been upgraded. This is also true of the facilities in Colorado Springs, for cable-laying, and so on.

Clearly, the intent of the National Environmental Policy Act is to assess the impact of these actions before they take place. In this case, it's being done after the fact.

Furthermore, the No-Action Alternative described in the PEIS is clearly not a No-Action Alternative. It

would merely halt the system-wide integration of the proposed BMDS. All of the components would continue, even to the point of deployment, apparently without the required completion of the appropriate EIS study.

As such, I would support a true No-Action Alternative that would allow testing and development to continue but prohibit deployment of this system or its component parts until such an alternative is considered.

To comply with the law, all current activity should cease until this PEIS process is completed. The current path clearly undermines the intent of the law, and that path should be changed.

Second, the PEIS does not consider the broader environmental impact of the systems deployment. Specifically, the PEIS does not consider how deploying the missile defense system will affect the political and security environment.

It is quite possible, if not likely, that deploying this missile defense system will increase the likelihood of a nuclear weapon being detonated. Obviously, such a detonation would cause an enormous negative environmental impact.

The reason the BMDS makes detonation more likely is quite simple. Both Russia and China will seek to

maintain the capability to defeat or overwhelm this missile defense system. In Russia's case, if expansion of the U.S. system proceeds, they could be compelled to maintain a larger arsenal on higher alert, than they otherwise would. Russian President Vladimir Putin has already announced that Russia is developing new missile technologies intended to counter U.S. defenses.

Specifically, Russia is looking at equipping its new Topol missile with multiple warheads and has tested a maneuverable warhead designed to defeat U.S missile defenses and also is planning to maintain its 10-warhead SS-18 ICBM otherwise scheduled for decommissioning.

It is much worse in China's case. With currently a relatively limited arsenal of 20 long-range missiles capable of striking the United States, even the extremely modest system being deployed by the United States will quickly become at least a theoretical threat to the survival of China's nuclear deterrent.

The goal, of course, of U.S. policy, must be to eliminate or at a minimum limit the nuclear threat to the United States. We absolutely do not want China to maintain it's nuclear deterrent, but deploying missile defenses while maintaining our own extremely robust

nuclear arsenal ensures that China will hold onto its arsenal and, in all probability, increase it.

In fact, a 2000 National Intelligence Estimate specifically found that China was likely to increase the size of its nuclear arsenal in response to the deployment of U.S. missile defenses. China is already pursuing a vastly upgraded missile arsenal of longer-range, multiple-warhead mobile land- and sea-based missiles with increased accuracy. The key variable is how quickly and how robustly they will pursue these upgrades.

In short, the missile defense system will push China to develop and deploy a larger and more capable nuclear arsenal. Russia will maintain and perhaps upgrade its nuclear arsenal, much of it on high alert. Both those factors contribute to an increase in the likelihood of a nuclear attack, either intentional or accidental, on the United States. There could be no worse outcome for the environment.

The PEIS also considers a space-based weapons alternative. Such an alternative could also have severe negative implications for the overall security environment. Placing weapons in space would provoke a number of other countries to develop responses that would

decrease overall US security. These impacts should be considered in the PEIS.

Thank you.

MR. BONNER: Thank you.

Lenny Siegel.

MR. SIEGEL: Good evening. My name is Lenny Siegel with the Center for Public Environmental Oversight. I've reviewed the draft Programmatic Environmental Impact Statement with a focus on the use of solid rocket propellant, and I've found that the document is woefully inadequate and doesn't meet the purposes of NEPA, and I'll explain why.

NEPA is a law, which is designed to evaluate environmental alternatives so you can see what you can do better. You're supposed to do a cradle to grave analysis, someone mentioned this, not just to justify decisions that have already been made but to figure out ways to mitigate the problems, to do things differently to solve the problems.

I don't see that in this document. There's no genuine No-Action Alternative. Now, it may be that once you do your study, you would conclude that the No-Action Alternative doesn't meet the purposes of the program, but it's supposed to be there as a baseline against which to

measure the environmental impacts. If there's no solid rocket propellant being used, then, you aren't going to deplete the ozone layer; you aren't going to cause water pollution. That alternative should be there for the study to follow NEPA.

Solid rocket propellant, for those who don't know, just about all of it these days contains aluminum and ammonium perchlorate. When it burns as designed, it generates hydrogen chloride, as the document says. When that's released in the lower atmosphere, it combines with moisture to form acid precipitation. That's something that needs to be mitigated. It causes environmental impacts.

It's important to look at alternative launching technologies to avoid those impacts. I see nothing in the document looking at alternative launching technologies.

If the rocket makes it up to the upper atmosphere, the hydrogen chloride breaks down and depletes the ozone layer, exposing us creatures all around the world to ultraviolet B radiation, which causes cancers and numerous other environmental consequences. At the very least, this document should look at ways that alternative technologies, other launching technologies could eliminate or reduce that impact.

It does not do it. Instead, it compares, and I come up with a higher number, compares the launch-caused ozone depletion to industrial emissions. Those industrial emissions that EPA is calculating every year are actually the emissions caused by the residual release of chemicals that are banned now and are not being produced anymore. And gradually, those are going to be going down because we don't use CFCs anymore around the world. But it looks like the ozone depletion from hydrogen chloride from launching is going to go up unless we look for other ways of launching rockets and missiles.

And finally, I'm from California. We've got a big problem in California and Nevada, Arizona. Twenty million people are drinking water that is contaminated with rocket fuel, perchlorate. It's a growing problem around the country. Perchlorate causes developmental disorders in children. There's no calculation in this document about how much perchlorate needs to be produced to make this system happen, not just for the testing but for the deployed missiles. Presumably--there's no count of how many missiles might be deployed in the system, yet we're going to be manufacturing, disposing of either during manufacturing, during testing or even decommissioning this contaminant.

It is not there. You are not analyzing it. In order to follow NEPA, you have to analyze how much perchlorate might be released into the environment and how you might come up with ways of mitigating that problem or coming up with alternative launch strategies or not doing it at all.

So in order for this document to meet the obligations under the law, there's a need to, one, provide more detailed estimates of perchlorate waste likely to be generated by the system's development, testing and deployment, maintenance and decommissioning and acknowledge emerging regulatory standards for perchlorate exposure; two, consider in detail the management practices, launch protocols, treatment technologies, et cetera, necessary to mitigate the significant environmental impacts, including ozone depletion and the likely release of perchlorate into ground water, surface water and soil; and three, evaluate launch technologies not based upon ammonium perchlorate.

Subsequent studies, site-specific studies, tiered studies doesn't do the job, because there's no way you can do that and look at an alternative to the way it's being done now. You can't substitute for perchlorate five years down the road. It has to be done while the system

is testing, or the system that you're testing won't be the system you deploy.

Thank you.

MR. BONNER: Thank you for your comments and input.

At this point, we invite everyone to stay, come back to the poster area, where you can ask clarifying questions of the MDA folks who will be around for the next hour to answer your questions or comments.

Marty?

MR. DUKE: Again, I would just like to thank you for coming and providing your comments. We'll look at those comments and consider those in the draft PEIS. Just one point: the programmatic--you made some very good points, and, you know, we understand there's a lot of issues out there, and a lot of additional tiering environmental analysis will have to be done before any decisions are made in the future. So we're providing a baseline identifying the areas that need further analysis.

Again, thank you very much.

[Whereupon, at 8:22 p.m., the meeting was concluded.]

Exhibit B-14. Sacramento, California Public Hearing Transcripts

MISSILE DEFENSE AGENCY

In Re: MDA Ballistic Missile Defense System Programmatic Environmental Impact Statement Public Hearing

PUBLIC HEARING

TUESDAY, OCTOBER 19, 2004

6:31 P.M.

Hearing Held At: Sheraton Grand Hotel
1230 J Street
Sacramento, California

Reported by: Desiree C. Tawney, CSR No. 12414

APPEARANCES:

Marty Duke

Colonel Mark Graham

Peter Bonner

Sacramento, California; Tuesday, October 19, 2004
6:31 p.m.

MR. DUKE: First I'd like to welcome --

UNIDENTIFIED SPEAKER: We can't hear you.

MR. DUKE: Can you hear me now?

UNIDENTIFIED SPEAKER: Move it up a little bit.

MR. DUKE: Again, I would like to welcome each and every one of you to tonight's public hearing for the Missile Defense Agency Ballistic Missile Defense System Environmental Impact Statement.

This public hearing is being held in accordance with the NEPA Environmental Policy Act -- excuse me -- the National Environmental Policy Act or NEPA.

My name is Marty Duke. I am the Missile Defense Agency's Program Manager for the development of the Programmatic Environmental Impact Statement.

I would like to introduce Colonel Mark Graham, who is with the Missile Defense Agency's Office of General Counsel. Colonel Graham will talk about the Draft Programmatic Environmental Impact Statement, the NEPA process and the Ballistic Missile Defense capabilities and components.

I also would like to introduce Mr. Peter Bonner, Ms. Deb Shaver in the back, who is with ICF Consulting.

Ms. Shaver is the ICF Consulting Program Manager and the technical lead for PEIS.

Mr. Bonner --

UNIDENTIFIED SPEAKER: What is ICF, please?

MR. DUKE: ICF is -- letters. It does not represent a name. It's ICF Consulting. It is the name of the company they work with.

UNIDENTIFIED SPEAKER: ECF?

MR. DUKE: ICF.

UNIDENTIFIED SPEAKER: UCF?

UNIDENTIFIED SPEAKER: We're going to give you a hard time.

MR. DUKE: That is fine. That is why we're here, to listen to you provide your comments.

With that, I'd like to turn the meeting over to Mr. Bonner, who will go over tonight's agenda and discuss some administrative points on how to provide the public comments on the Programmatic EIS.

MR. BONNER: Good evening. I'd also like to welcome you to the public hearing. We're from DC so we have to have some acronyms for tonight's meeting. We'll refer to the Missile Defense Agency as MDA during this presentation.

We'll review the Ballistic Missile Defense System or BMDS. We'll discuss the Programmatic Environmental Impact

Statement as a PEIS.

Therefore, at tonight's hearing, we'll discuss the development of MDA's draft BMDS PEIS. There is a test at the end.

Next we'll discuss the proposed action, which is the implementation of an integrated BMDS, the activities involved in implementing the BMDS, which have been analyzed for the potential environmental impact. Finally, we'll provide a forum to collect your public comments on the Draft PEIS.

It's our goal to have an open informative process tonight. To ensure MDA has enough time to receive your oral comments, we'll use the following agenda for tonight's meeting: We'll spend -- the first portion is a 30 to 40 minute presentation with information about BMDS, the NEPA process, the National Environmental Policy Act and our analysis.

The presentation will discuss: What is a Programmatic EIS? What is the BMDS? How were potential impacts analyzed? What were the results of the analysis? And how to submit comments on the Draft PEIS.

We'll then take a 15-minute break where you'll get a chance to sign up at the registration table, if you haven't already, to provide some of your oral comments. After the break each speaker will be called in the order

they've signed up to come and make their statements.

Following the public statements MDA representatives will be available at the poster area to help clarify any information you might need.

Please note the questions and comments provided in the poster area will not be officially recorded. However, all questions can be formally submitted today to MDA through other available methods.

The most important aspect of tonight's meeting is to hear your comments in the public comments portion. All public statements provided tonight will be recorded in a transcript.

Please remember that the Programmatic -- the PEIS is a draft document. This is your opportunity to provide comments on the document before it's finalized and before a decision is made.

We're going to listen firsthand to your suggestions and concerns. As you give your oral comments, please limit your comments to three minutes. I think we've got 25 or 30 folks who want to make public comments.

The purpose of the meeting is to gather the comments. We'll attempt to answer your questions, clarifying the points we've made in the presentation out in the poster area. Substantive questions recorded tonight will be carefully considered in the Final PEIS.

If you wish to provide written comments, forms are available at the registration table. You may leave the written comments with us at the registration table. You also have options to email, fax or voicemail your comments to us.

To allow time to consider and respond to the comments in the Final PEIS, we need to receive your comments -- your comments must be received by November 17.

Colonel Graham will discuss the BMDS PEIS and the NEPA process.

Thank you.

COLONEL GRAHAM: Thank you, Peter. Can you hear me okay? Good.

NEPA establishes our broad national framework for protecting the environment. NEPA requires Federal agencies to consider the environmental impacts of proposed actions and the reasonable alternatives of those actions early in the decision-making process.

The NEPA process is intended to help public officials make decisions based on the understanding of environmental consequences and take action that protects, restores, and enhances the environment.

In the past, the national approach to the missile defense focused on the development of the individual missile defense elements of programs such as the Patriot,

Airborne Laser and ground-based interceptors. These actions were appropriately addressed in separate NEPA analyses that MDA, its predecessor agencies, and executing agents prepared for these systems.

The aim of missile defense has been refocused by the Secretary of Defense to develop an integrated Ballistic Missile Defense System that would be a layered system of components working together, capable of defending against all ranges of threat missiles in all flight phases.

Because the integrated Ballistic Missile Defense System is a large program made up of many projects implemented over time on a worldwide basis, MDA has determined a programmatic NEPA analysis would be appropriate.

Therefore, MDA has prepared a Programmatic EIS to analyze the environmental impact of implementing the proposed program.

The Programmatic EIS or PEIS analyzes the broad environmental consequences in a wide-ranging Federal program like the BMDS. A PEIS looks ahead at overall issues in a proposed program and considers related actions together in order to review the program comprehensively.

A PEIS is appropriate for projects that are broad in scope, are implemented in phases and are widely dispersed geographically. A PEIS creates a comprehensive

global analytical framework and supports subsequent analysis of specific activities of specific locations. The Programmatic EIS is thus intended to serve as a tiering document for subsequent specific Ballistic Missile Defense System analyses and includes a roadmap for considering impacts in resource areas and developing future documents.

This roadmap identifies how a specific resource area can be analyzed and includes specifics for considering the significance of environmental impacts on specific resource areas. This means that ranges, installations, and facilities at which specific programs may occur in the future could tier their documents from the PEIS and have some reference point from which to start their site-specific analyses.

The Ballistic Missile Defense System Programmatic EIS analyzes the potential impacts of developing, testing, deploying and planning for decommissioning of the proposed program.

The Programmatic EIS evaluates the proposed Ballistic Missile Defense System's technology components, assets and programs and considers future development and application of new technology.

The proposed action considered in our Programmatic EIS is for MDA to develop, test, deploy and plan for

decommissioning activities for an integrated Ballistic Missile Defense System, using existing infrastructures and capabilities, when feasible, as well as emerging and new technologies to meet current and evolving threats.

When feasible, MDA will use existing infrastructure to implement the BMDS and would incorporate new technologies and capabilities as they become available. This would ensure the program could provide defense for both current and future missile threats.

The purpose of the proposed action is to incrementally develop and deploy a Ballistic Missile Defense System, the performance of which could be improved over time, and that layers defenses to intercept ballistic missiles of all ranges in all phases of flight.

The proposed action is needed to protect the United States, its deployed forces, friends and allies from ballistic missile threats.

In this Programmatic EIS, MDA considered two alternative approaches to implementing the Ballistic Missile Defense System in addition to the No Action Alternative. The alternative approach is to address the use of weapons for land, sea, air and space-based platforms.

Alternative 1 is to develop, test, deploy and plan for decommissioning for an integrated Ballistic Missile Defense System that includes land, sea and air-based

weapons platforms.

The BMDS envisioned in Alternative 1 would include space-based sensors but would not include space-based defensive weapons.

Alternative 2 is to test, deploy and plan -- develop, test and deploy, and plan for decommissioning an integrated Ballistic Missile Defense System that includes land, sea, air and space-based weapons platform.

Alterative 2 would be identical to Alternative 1, with the addition of the space-based defensive weapons. The Counsel of Environmental Quality Regulations implementing NEPA also requires consideration of the No Action Alternative.

Under the No Action Alternative, the MDA would not develop, test, deploy or plan for decommissioning activities for the integrated Ballistic Missile Defense System.

Please note that under the No Action Alternative MDA would continue existing development and testing of individual elements and stand-alone defensive capabilities. Individual systems would continue to be tested but would not be subjected to system integration testing.

Alternative 1 and 2 provide different weapons platforms through implementing an integrated Ballistic

Missile Defense System, while the No Action Alternative continues the traditional approach to developing individual missile defense elements.

I will now address how MDA characterizes the Ballistic Missile Defense System into relevant components and life cycle activities that could be considered to provide a programmatic overview of the environmental impacts of implementing the proposed action.

As mentioned earlier, MDA's goal is to develop an integrated Ballistic Missile Defense System that will provide layers of defense. The Ballistic Missile Defense System will be capable of destroying threat ballistic missiles in the boost, midcourse and terminal phases and would defend against short, medium, intermediate and long-range threat ballistic missiles.

Finally, the Ballistic Missile Defense System would integrate sensors and weapons through command, control, battle management, and communications or C2BMC network. With this capability the integrated Ballistic Missile Defense System would establish a defense against threat ballistic missiles.

The Ballistic Missile Defense System is a complex system of systems. To be able to perform a meaningful impact analysis, we've considered the Ballistic Missile Defense System in terms of its components; that is,

weapons, sensors, C2BMC and support assets.

These components are the building blocks that could be assembled with specific functional capabilities and could be operated together or independently to defeat threat missiles. Testing was considered for each component. However, the integrated Ballistic Missile Defense System needs to be tested at the system level and was analyzed separately using realistic system integration flight test scenarios.

Let's take a look at each of the components. First of all, we have weapons. Ballistic Missile Defense System weapons would provide defense against threat ballistic missiles. They include interceptors and directed energy weapons in the form of high-energy lasers. These weapons would be used to negate threat missiles. These interceptors would use hit-to-kill technology, either through direct impact or directed fragmentation.

Ballistic Missile Defense System weapons are designed to intercept threat ballistic missiles in one or more phases of flight that can be activated from land, sea, air or space-based platforms.

Sensors in the Ballistic Missile Defense System will provide relevant tracking data for threat ballistic missiles. Sensors detect and track threat missiles and assess whether or not the threat missiles have been

destroyed. Sensors provide the information needed to locate and track a threat missile to support and coordinate effective decision-making against the threat.

There are four basic categories of sensors considered in the Ballistic Missile Defense System. They are radars, infrared, optical and laser sensors.

Radars send a signal out and detect the same signal after it bounces off an object. Infrared sensors are passive sensors that detect and track heat or infrared radiation from an object. Optical sensors are passive sensors that collect white energy or radiation emitted from an object. Laser sensors use laser energy to illuminate and detect the object's motion. Radars and lasers emit radiation while infrared and optical sensors detect radiation that has been emitted.

The Ballistic Missile Defense System would operate the sensors; that is, would operate from multiple platforms: land, sea, air or space.

The data collected by the Ballistic Missile Defense System sensors would travel through the communication system to command and control centers where battle management decisions on whether to use a defensive weapon could be made.

C2BMC would integrate and coordinate equipment and operators through command and control and integrated fire

control centers. C2BMC would enable military commanders to receive and process information, make decisions and communicate those decisions regarding the engagement of the threat missile.

The C2BMC would include fiber optic cable, computer terminals and antennas and would operate from land, sea, air and space-based platforms.

The last category of components is support assets. The support assets would be used to facilitate developing, testing and deployment of the Ballistic Missile Defense System components. Support assets are one of three types: support equipment, infrastructure or test assets.

Support equipment includes general transportation and portable equipment such as automobiles, ships, aircraft, rail and generators. Infrastructure includes docks, ships, yards, launch facilities and airports. Test assets include test range facilities, targets, countermeasure devices, simulants and observation vehicles.

Now that we've discussed the components, Mr. Marty Duke will talk about how they can be integrated into the Ballistic Missile Defense System.

MR. DUKE: This slide depicts the various components of the proposed BMDS as we've just discussed. The use of the multiple defensive weapons and sensors operating from a variety of platforms integrated to a single C2BMC system

would created a layered defense allowing several opportunities to intercept and destroy threat missiles.

For example, one weapon could engage a threat missile in the boost stage. And another -- the boost phase being a threat area -- and the other could be used to intercept the missile threat in a later phase after an intercept was unsuccessful.

Components are integrated into the BMDS through the life cycle phase of the system acquisition process. These life cycles phases are development, testing, deployment, and decommissioning. These new components would undergo initial development, testing while existing components will be tested to determine their readiness for use. Work on a given technology would stop if testing failed to demonstrate effectiveness or its functional capabilities needs change.

Components and elements would be deployed as testing demonstrates that they are sufficiently capable of defending against threat ballistic missiles. In most cases, the components would be deployed when testing demonstrated that they are capable of operating within the integrated BMDS and the associated health and safety procedures are developed and adequate. This process concludes with decommissioning, which would occur when and where appropriate.

To determine the environmental impact, this PEIS analyzed the proposed BMDS components by considering the various life cycle activities of each component as well as the operating environment in which the activities are taking place. This slide tries to depict the multi-dimensional complexities involved in considering the impact of implementing the integrated BMDS in terms of its components -- which is the weapons, sensors, C2BMC -- the acquisition life cycle phases and their operating environments.

Because of the complex nature of this project an analysis strategy was developed to effectively, yet efficiently, look at the broad range of environmental impacts for the proposed BMDS.

First, the existing conditions of the affected environment were characterized for the location where various BMDS activities are proposed to occur. Next, MDA determined the resource areas that could potentially be affected by implementing the proposed BMDS.

Finally, impacts of the BMDS are analyzed in four steps. In Step 1, we identified and characterized life cycle phase activity; in Step 2, we identified activities with no potential for impact and dismissed them from further analysis; in Step 3, we identified similar activities across life cycles phases and combined them for

the analysis; in Step 4, we conducted the analysis -- the impact analysis for all remaining activities.

The first three steps were used to characterize and reduce the number of unique life cycle activities, thereby reducing the redundancy in preparing the impact analysis.

The affected environment includes all land, air, water, and space environments where proposed BMDS activities are reasonably foreseeable. The affected environment has been considered in terms of broad ocean area, the atmosphere and nine terrestrial biomes.

A biome is a geographic area with similar environments or ecologies. Climate, geography, geology, distribution of vegetation and wildlife determines the distribution of the biomes. The biomes encompass both U.S. and non-U.S. locations where the BMDS could be located or operated.

The resource areas considered in this analysis were those resources which could potentially be affected by implementing the proposed BMDS.

NEPA analyses generally consider resource areas listed on the screen except for orbital debris. Because missile defense development and test activities included launch and intercepting missiles, space-based communications and other satellites and potential for

space-based interceptors, MDA also considered orbital debris and its impact on the Earth. This PEIS discusses all resource areas, provides the methodology for analysis and suggests thresholds of significance to provide the reader with a roadmap for performing future site-specific analyses tiering from the PEIS.

These discussions outline the type of information that would be needed to conduct site-specific analyses to identify the steps necessary to ensure the potential impacts are appropriately considered.

The resource areas highlighted on the slide with the red star require site-specific information for analysis. These resource areas are more effectively addressed in subsequent tiered analysis for specific activities. Once we decided how to consider the affected environment and resource areas of concern, we used the four-step process I mentioned before to conduct the impact analysis. I will discuss each step in more detail.

In Step 1 of the impact analysis, MDA identified and characterized the activity associated with each BMDS component. Each life cycle phase has activities applied to each component. For example, development can include planning, research, system engineering and site preparation and construction. Testing can include manufacturing, site preparation, construction,

transportation, activation and launch activities. Deployment can include manufacture, site prep and construction, transportation, activation, launch operation and maintenance upgrades and training. Finally, decommissioning is demilitarization and disposal.

Once life cycle activities were identified it was determined that some of the activities have no potential for impact. The activities such as planning, budgeting, system engineering and tabletop exercises are generally categorically excluded in various Department of Defense NEPA regulations and are therefore not further analyzed in this PEIS.

Other activities for specific components such as transportation, maintenance and sustainment, and manufacturing are not analyzed in this PEIS because they have been evaluated in previous NEPA analyses and were found to have no significant environmental impact.

The remaining activities were then examined to determine which activities had similar environmental impacts. For example, impacts associated with site preparation and construction in the development phase would be similar to or the same as the impacts from site preparation and construction activities in the deployment phase.

Under Step 3, similar activities occurring in

different life cycle phases were identified and considered together to reduce redundancy.

The final step was to determine the impact associated with each remaining activity under the proposed action. The significance of the impact is a function of the nature of the receiving environment and the receptors in the environment. For example, an interceptor launch creates the same emission no matter where it's launched. Whether those emissions cause impact, the significance of those impacts depend on the environment in which they are released. The PEIS analyzed these emissions by component for each resource area and life cycle activity where a potential for impact was identified.

Impacts were distinguished based upon the different operating environments: land, sea, air and space. The analysis also considered specific impacts for individual biomes where activities could occur. The impacts of system integration testing was considered separately from the impact of the individual component testing.

Integration testing involved using multiple components in the same test. To deal effectively with integration tests, MDA looked at two generic system integration flight test scenarios which involved a different number of launches and interceptors. The impact analysis for Alternative 1 considers the use of land, sea

and air-based platforms for BMDS weapons.

The analysis includes the use of space-based sensors but not space-based weapons. The analysis was specific for each resource area based on the impact from the activities associated with the BMDS components.

The impact analysis for Alternative 2 includes the use of interceptors from land, sea, air, and space-based platforms for BMDS weapons. The impacts associated with the use of interceptors from land, sea and air platforms would be the same as those discussed for Alternative 1. Therefore, the analysis of Alternative 2 focuses on the impact of using interceptors from space-based platforms.

The fundamental difference between Alternative 1 and 2 is that Alternative 2 includes the analysis for space-based platforms for interceptors.

The cumulative impact of implementing the BMDS was also considered. The cumulative impacts are defined as impacts that result from the incremental impacts of the proposed action when added to other past, present, or reasonably foreseeable future actions. Because this proposed action is worldwide in scope and potential application, only activities similar in scope have been considered for cumulative impact.

Under Alternative 1 worldwide launch programs for commercial and government programs were determined to be

similar in scope; therefore, the impact of BMDS launches would be considered cumulatively with the impacts from other worldwide government and commercial launches.

Alternative 2 includes placing defensive interceptors in space, which involves adding additional structures in space for an extended period of time. The International Space Station was determine to be an action that is international in scope that has a purpose of placing structures in space for an extended period of time; therefore, the impacts of the use of space-based weapons platforms were considered cumulatively with the impacts of the International Space Station.

The next few slides provide broad summaries of the impact analysis by the BMDS components and Test Integration for Alternatives 1 and 2, a No Action Alternative and the Cumulative impacts for Alternatives 1 and 2. Please note the results are extremely high level, suitable for this presentation. Additional details have been provided in some of the posters in the back room in the hallway. And, also, the impact analysis may be found in the Executive Summary Impact Tables and in Section 4 of the Draft PEIS.

It's important to note that no environmental showstoppers were found in the Programmatic Environmental Impact Analysis. As the next few slides show, there are

potential impacts associated with the various activities needed to implement the BMDS; however, they would be appropriately addressed in subsequent tiered NEPA analyses along with the mitigation actions, as required, to ensure less than significant impacts.

This slide shows the summary of the broad potential for environmental impacts associated with the BMDS weapons activities, as examined, for each resource area for Alternatives 1 and 2. Please note, this is a very high-level depiction of the results of the analysis. And additional details of the weapons analysis can be found in the tables of the Executive Summary and the Draft PEIS. However, one can see from this slide the general activities and resource areas that should be considered in subsequent tiered NEPA analyses.

This slide shows the impact summary for the BMDS sensor components. Note the impacts are the same for Alternatives 1 and 2 and include space-based sensor platforms. This summary also shows how MDA characterization of activities helps to simplify the analysis. For example, the activation of the radars would not impact air quality because the only emissions resulting from radars would be from supporting diesel generators, which are addressed under support assets. However, radars generate electromagnetic radiation which

could potentially impact biological resources.

Although C2BMC is the glue that enables the integrated BMDS to function effectively as a system, this component creates little potential for environmental impact.

Impacts associated with support assets are mainly those that would be caused by site-preparation and construction of the infrastructure and by using test assets such as countermeasures and simulants during testing.

Test integration overall has the most potential for impact because it includes the use of several components during increasingly realistic test scenarios. Although this programmatic analysis shows the potential for impact, the existing environment of the post-test location of the specific test activities plan would determine the nature and extent of the impact.

The No Action Alternative would continue the development and testing of individuals weapons, sensors, C2BMC and support assets and would not include integration testing of these components. The environmental impact of the No Action Alternative would be the same as the impact resulting from continued development and testing of the individual missile defense elements. The decision not to deploy a fully integrated BMDS could

result in the inability to respond to a ballistic missile attack on the U.S. or its deployed forces, allies or friends in a timely and successful manner.

Further, this alternative would not meet the purpose or the need of the proposed action or the specified direction of the President or the United States Congress.

We examined the impact of the worldwide launches for cumulative impacts. Launches can create cumulative impacts by contributing to global warming and ozone depletion. Central launch emissions that could affect global warming include carbon monoxide and carbon dioxide, which is CO2. Unlike C02, carbon monoxide is not a greenhouse gas; it can contribute indirectly to the greenhouse gas effect. Cumulative impact on global warming of emissions from BMDS launches would be insignificant compared to other industrial sources, such as energy generation.

The BMDS launch emission load of C02 and carbon monoxide would only be 5 percent of the emission loads for worldwide launches. In addition, C02 and carbon monoxide in 10 years of BMDS and worldwide launches combined would account for much less than 1 percent of C02 and carbon monoxide emissions from U.S. industrial sources in a single year.

Chlorine is a primary concern with respect to ozone

depletion. Launches are one of the man-made sources of chlorine in the stratosphere. The cumulative impacts of stratospheric ozone depletion from launches would be far below the effect caused by natural and man-made sources. The emission loads of chlorine from both BMDS and other launches worldwide occurring between 2004 and 2014 would account for half of 1 percent of the industrial chlorine load from the U.S. in a single year.

The orbital debris produced by BMDS activities would be generally small in size and consist primarily of launch vehicle hardware, old satellites, and bolts and paint chips. It may also be possible for debris from an intercept to become orbital debris. However, orbital debris produced by BMDS activities would occur in low Earth orbit where debris would gradually drop into successively lower orbits and eventually reenter the atmosphere; therefore, orbital debris from BMDS activities would not pose a long-term hazard to the International Space Station or other orbiting structures.

In addition, collision avoidance measures would further reduce the potential for orbiting debris to damage structures in space such as the International Space Station.

I'd like to reiterate that our impact analysis indicated no showstoppers or expected areas of significant

impact. However, many resource areas showed potential for impact indicating these areas need to be considered in subsequent analyzed analysis tiered from the PEIS.

Now, I'd like to turn the meeting back over to Peter who will talk about the administrative process and how we're going to take the public comments.

MR. BONNER: Thank you, Marty. Now that we've looked at the proposed BMDS and the potential impacts of implementation, let's discuss the PEIS schedule.

The Notice of Intent was released April 11 of 2003 in the Federal Register. The MDA released the Draft PEIS in September 2004.

The public comment period, which we're in right now, will continue through November 17, 2004. After that time the MDA will consider all comments received and incorporate appropriate changes into the Final PEIS. A release date for the Final PEIS is estimated between December and January 2004 -- 2005.

After release of the Final PEIS, there will be a 30-day waiting period before the MDA can issue the Record of Decision or ROD. I think that is our last acronym.

There are a number of ways in which you can provide comments on the Draft BMDS PEIS. You can provide your comments orally or in writing. Oral and written comments will be given equal consideration in the Final PEIS. If

you would like to make a public statement at tonight's meeting, please sign up at the registration table and fill out a speaker's card during the break.

Each speaker will be given five -- or three minutes to make a statement, as mentioned earlier. Public statements by tonight's speakers will be recorded by a court reporter to ensure that we accurately capture your comments on the Draft PEIS. There is also a toll-free telephone number that you can use to submit comments.

Please refer to the handouts you've got for the toll-free telephone number. Another option is to submit your comments in writing. There are four ways to do that. You may leave your written comments with us if you brought them with you. Second, you can use the comment forms available at the registration table to write down your comments and also leave those with us. You can either turn them in tonight or fax them to us. Third, you can email your comments to MDA at the email address listed on the screen. Finally, you can submit your comments through the PEIS website on an electronic form we have.

Again, to ensure your comments are adequately considered in the Final BMDS PEIS, they must be received no later than November 17.

The information on the screen lists the various ways you can submit comments. Information is also listed on

the comment forms on the registration table, the MDA PEIS website, and the handouts near the posters. Please visit the BMDS PEIS website for additional information. The website provides the descriptions of the topic areas we touched on this evening, as well as links pertaining to additional information. The materials handed out tonight are posted on the BMDS PEIS website.

We encourage you to sign up for the hard copies of the Executive Summary of the Final PEIS and the CD-ROM containing the entire document when it becomes available. To do this, please fill out the appropriate forms at the registration table. You can also request a copy of the Executive Summary or CD-ROM of the entire document by sending us an email, again, at the address listed on the screen. The Final PEIS will be also be available in pdf format to download from the website and hard copies will be placed in local libraries. A list of these libraries is available on the website.

Marty, final comments?

MR. DUKE: Again, our role here tonight is to provide you the opportunity to address your concerns firsthand so we can consider those in the preparation of the Final PEIS.

Remember, no decisions on this project will be made tonight. But you -- we do want to make sure you have the

opportunity to provide us the comments. Again, please provide comments in the various methods that Peter explained. I think there is a handout with all of that information you can pick up and take with you but we need the comments and request they be submitted no later than November 17th(sic).

Now we are going to take about a 10 to 15-minute break to set up for the public statements period. You can sign up at the registration table if you'd like to make a public comment.

After the public comments period we'll be available back at the poster areas to answer any further questions you may have. Okay.

Thank you.

MR. BONNER: Also, if you didn't sign up when you first came in, even if you are not making a public comment, if you could sign up at the front table.

Thank you.

(Brief recess taken from 7:11 p.m. to 7:26 p.m.)

MR. BONNER: Let's come back together and let's get started.

Can you take your seats, please. I have the list of registered speakers and I'll call each person to the microphone to speak.

Again, please limit your remarks to three minutes.

To help you keep track of time, after about two and a half minutes I'll hold up this very professionally done sign and you'll know you need to wrap up.

If you do have a written version of your comments, we ask you provide that to us so we can accurately keep a record of your statements. When providing your public comments, remember to state your name and your affiliation as clearly as possible so we can pick it up as we record the meeting.

If you don't wish to give an oral statement tonight, please take advantage of the many opportunities we've tried to lay out for you to make other comments.

With that, let's start. Alan Stahler. Is it Stahler or Staler(phonetic)?

ALAN STAHLER: Stahler. My name is Alan Stahler. I live in Nevada City, California. The World Trade Center towers were not taken down --

MR. BONNER: One second. Two, three --

ALAN STAHLER: My name is Alan Stahler. I live in Nevada City, California. The World Trade Center towers were not taken down by ballistic missiles. The USS Cole was not attacked by ballistic missiles. The Federal Building in Oklahoma City was not destroyed by ballistic missiles. Any country knows that we know that they know that we know that any launch of a limited ballistic

missile attack, as described in the handout we got today, would be suicidal.

They know that we know that they know we know their country would be dust in an hour of any such attack. The handouts says four-fifths of the tests of the system so far were interceptions. I realize that that depends on what your definition of what "interception" is; but in most of the world, almost only applies in horseshoes. I'd like to know what would be the environmental effect, the environmental impact if the system is deployed but does not work?

What are the immediate effects to the environment in which we live? What are the effects of our environment on how we live on diverting financial resources? The handouts didn't say anything about what this would cost now or in the future. What are the effects on our environment of diverting the intellectual resources that could go to better places? What are the environmental effects of diverting skilled work that could be applied to building schools, libraries, roads, bridges, you name it?

MR. BONNER: Thank you. Miles Everett.

MILES EVERETT: Thank you all for this opportunity. My name is Miles Everett. I'm from Healdsburg, California. I'm involved with the Alliance for Democracy and that is what brings me to these particular concerns.

I, too, am concerned about a broader definition of environment. And one of the things that concerns me a great deal about this present project is that the technical environment for making it work does not seem to be up-to-speed. The Union of Concerned Scientists says that the project that is about to be launched has no assurance of working at all. And Thomas Christy, who is the head of one of the testing agencies of the Pentagon, says he has no assurance that the part of the system about to be deployed would even protect Alaska against a missile from North Korea.

I'm also concerned about the financial environment. Apparently, a hundred billion dollars has been spent thus far. 10 billion more is asked for 2005; another 53 billion for 2004 and 2009. The layered project, I would suggest, is a kind of a cover for a blank check, which will keep us paying for these weapon systems until we're all gone.

We have a huge deficit. We have many demands and yet they want to dig that deficit hole much deeper by this particular project. What about the environment for international relations? What is world opinion to make of this situation where the United States charges ahead because it's rich enough to -- to try to build an umbrella which protects it, at the same time it announces its

policies of preemptive war.

We already had one comment from an Iranian general who said, "Well, clearly, if you're going to be dealing with the United States in the future, you have to have nukes or you can't even get their attention."

What about American opinion? The idea that somehow we'll be safer under this umbrella, which will be sold -- you can imagine -- the Whitehouse and the Pentagon will sell this idea right off the face of the earth that now we're going to be safe under this umbrella.

I thought that I heard a number of times from this Administration that 911 changed everything. And it ought to have changed this 21-year-old strategy that goes back to the Cold War before we had a great many of the satellite surveillance systems and so forth that cover the entire globe that make it impossible for anybody to set up without us knowing about it and be able to follow the process.

MR. BONNER: You've got about 30 seconds.

MILES EVERETT: It does not do anything, obviously, to address the great multitude of threats that have been so much talked about since 911. It's simply a huge distraction from our real problems of learning how to live on this globe with all of the people on the globe. And the implications -- finally, the implications of

destroying missiles, which presumably would be nuclear armed missiles, destroying them in flight and suggesting that is a worthy desirable objective is a -- that is a very dubious proposition.

They will tell you that the nuclear warhead does not necessarily explode. But certainly the technology that can create this mammoth system can also create a system which would cause a nuclear warhead to explode when and if it's intercepted.

So we have warheads going off around the globe wherever we happen to intercept it. That does not create a very attractive environment for human beings.

MR. BONNER: Robert Alpern.

ROBERT ALPERN: Good evening everyone. Thank you for the opportunity to have citizens' comments.

I think we've said that the environment is much broader than what this statement calls for. The environment is a social and cultural environment that we need to take into consideration as we consider building such a new and costly provocative system.

The National Intelligence Estimate of 2001 for the Bush Administration says, and I quote, An attack on U.S. territories is more likely to be -- we are more likely to be attacked by countries or terrorists by using ships, trucks, airplanes or other means, rather than long-range

ballistic missiles.

We're still in the era of the Cold War in thinking about these missiles and this program to create this artificial and flawed umbrella for the people of this country. What are the effects on other countries of this provacative system? It is thought likely that China will increase its production of nuclear weapons to overwhelm this system, which is very easily overwhelmed by decoys and numbers. This system, as we now know it, is meant to ideally knock out a very few incoming missiles, not at all the kind of attack that possibly could occur. It is flawed in that respect.

The Pentagon itself in an analysis called the Ballistic Missile Defense System, a Case Study Against Rushing Forward on a Missile System. The Pentagon itself said that. And yet we're -- we have spent a hundred billion dollars. We're planning to spend 83 billion more over the next ten years and we have nothing to show for it except neglected communities, depleted healthcare systems and actual environmental neglect of the real environments that we all daily live in.

This proposal that we're asked to address tonight does not contain a real No Option Alternative not to build the system, to abandon it. That is what I think most of the people in the United States and the world would

affirm.

This system's impact on traditional arms control and disarmament efforts would be profound. We've already vitiated the Anti-Ballistic Missile Treaty under this Administration. We're preparing to resume nuclear weapons testing at the Nevada test site. We're building a whole series of new nuclear weapons, the mini nukes and bunker buzzards.

We're prepared to fight preemptive wars and yet this antiquated system that is going to cost you and I and our fellow Americans the treasures of our society that are already depleted by the Iraq war and other weapons spending, we're asked to do this. And I say we must abandon this program and utilize our resources in more constructive ways and practicing the ways of diplomacy negotiations and building alliances, instead of acting unilaterally, which is what this program does.

Thank you.

MR. BONNER: Karen Blomquist.

KAREN BLOMQUIST: Hi. I'm a nurse and I therefore know the difference between preventive care and just treating the symptoms.

Star Wars just treats the symptoms of aggression. And like most efforts to treat the symptoms, while ignoring the real problem, these efforts will make the

problem worse. As an example, taking an aspirin for a headache, which is a symptom of an impending stroke, is not going to help the problem.

Star Wars is an aggressive move that will only foster aggressive feelings and eventually aggressive actions from other countries. Continuing to bully other countries around is not going to win us alliances. It does just the opposite. Most countries, if not all, will end up hating us. And as it fosters this aggressive action, Star Wars will clog up the space over our Earth. The consequences of which we do not fully know.

Like food additives that are now found to cause -- or possibly cause mood disorders and ADD, what might clogging up the space surrounding Earth with satellites and debris do? While we shoot more satellites up into air spewing perchlorate into our atmosphere, how much of our ozone will be left to protect all life from destruction of the sun's rays?

If the satellites break and accidentally misfire or fire on their own, how many satellite or accidental misfires will it take before World War III?

Star Wars is an action of those who do not -- do not live in reality but live in some -- but live in some self-centered devil worshipping dream world of control that will ultimately cause the rest of us who live in a

nightmare of terror, while destroying the very Earth upon which we live.

MR. BONNER: Thank you, Karen. MacGregor Eddy.

MACGREGOR EDDY: Hi. I came here from Salinas to speak on this. And in Salinas they're proposing closing all of our public libraries. Why? Because they don't have enough money.

Well, where is the money going? I propose that 1.3 trillion dollars for Star Wars is a good example of where the money is going. Closing all of the public libraries completely in a town that is 66 percent Hispanic American, in a town that produces 80 percent of the lettuce you eat.

Let's take a look at what the program is. And I'll address it environmentally. I have copies of my statements if anybody wants it. Here you go. Here. Pass them around.

Statements from MacGregor Eddy. I'm an advisory board member of the Global Network Against Weapons and Nuclear Power in Space regarding the Programmatic Impact Statement of the PEIS Ballistic Missile System presented October 19th, Sacramento, California.

One, the 515 launches which is far more than the 99 commercial launches that are proposed. By the way, I came here expecting a fairly honest presentation of the PEIS and I was shocked at the scummy lies I heard by people I

regard as honest people. It's ridiculous that the -- there is 515 launches proposed for Star Wars. That is five times the amount that would be launched under the programs that are non-Star Wars. And you can look this up for yourself. Don't trust me. Check it out.

The second thing is the PEIS is based on the Star Wars program as proposed -- and here we have a statement. Okay. This statement was made by General Henry Tray Obering. He's the head of the Missile Defense Agency. So this is not a statement from some conspiracy website. This is a statement from the head of the MDA. What did he say when he was speaking at a Homeland Security conference on a missile defense panel on October 13th in Colorado Springs, Colorado? He was asked about the THAAD, which is the Theater High Altitude Defense Missiles that are scheduled to go into production in 2005. He was asked about these.

What did General -- General Henry Tray Obering say about the missiles? He said, quote, These missiles are intended to augment, not replace, the current generation of ground-based midcourse interceptors.

That is what we're talking about here tonight, ground-based midcourse interceptors. In fact, there will be a continued spiraling of the capabilities of missile network with more missiles and additional sites added to

the current missiles and expansion of the Theater High Altitude Defense Missiles beyond the initial scheduled 25 missiles. Therefore -- hey, listen. Therefore, the program they're talking about includes far more missiles than the ones they're proposing.

The second thing is the PEIS does not evaluate the environmental impact of No Action Alternative; thus, does not comply to the National Environmental Policy Act.

And three, the PEIS does not address the environmental impact of the response to ballistic missile defense systems by other countries. For example, China is planning to increase the number of missiles they have in direct response to our ballistic missile program. And this PE -- this Environmental Impact Report does not address the effect of testing, deployment and decommissioning of these two missiles in China, which is a direct result of our policy. And this is not included in the Environmental Impact Report.

The report -- since No Action Alternative was not considered seriously in the impact report, I say it is not an impact report at all. Therefore, it has not complied with the legal requirements; therefore, it should be stopped.

Thank you.

MR. BONNER: Thank you. Rod Macdonald.

ROD MACDONALD: I'm Rod Macdonald. I'm a professional wetland scientist. I work with identifying wetland ecosystems, their components, soils, water quality, their functionality. I modify them, restore them, recreate them under occasion, so forth. So I know what I'm talking about. I'm a registered wetland scientist, which means, like a structural engineer, Im educated. But I have a reputation to lose, if I don't get the facts right.

I guess what disturbs me is I read Science Magazine. It comes out 52 times a year. It's uncensored. You'd be surprised of the things you'll see in there. Anyway, there is a lot of discussion about missile systems that comes from the point of view of the National Academy of Science. And, of course, there is a broad range of opinions of scientists, like anyone else. It's sort of a scientific engineer-based discussion.

I want to talk about what an Environmental Impact Statement is supposed to be under the NEPA, National Environmental Quality Act. It's supposed to look at a cradle-to-grave analysis of a project. It's supposed to minimize the impact at every state, in every level, every decision within it.

I really think it's a great thing to take a program like this which has a huge cumulative impact and look at

it in a systematic cumulative way. That's what it says it does; but, unfortunately, it's not what it does. It provides a false set of figures upon which to compare what the real impacts would be. Instead of trying to look at where we have to go if we want to deploy the system -- I'm not willing to take a stand about whether I agree the system should or shouldn't be built. I think despite all terrorism, the possibility of a missile launched from a disguised container off of the coast is realistic and we'll never know who put it in that container but we'll need to shoot it down.

But my argument isn't with the waste of money, if it may be an overblown system or its provocative nature; but, instead, it really does not address what is going on. And the reason it doesn't is it provides -- I'll look at perchlorates. Perchlorates are important to amphibians. Amphibians are in a worldwide decrease.

If you look at the report, all the report ever says is "hazardous waste will be handled and dispersed in accordance with appropriate regulations; therefore, no significant hazardous materials and hazardous waste impact will be expected."

They go through and they say this for every single thing. The vegetation and so forth won't be or "we'll do a tiered-site analysis and a certain site will be

affected" but it won't. But the truth is over the decade life of the program, the global level of perchlorates may rise. Amphibians skin needs to be moist. They're very sensitive to all industrial chemicals. 70 percent of the species are in decline right now, even in habitats that aren't disturbed.

Why would we care about them? The mosquitos are coming out. We don't have hard figures. We don't have real analysis. We're told this is a half a percent. What they're disguising there is most of the chemicals are residual from former manufacturing processes. And even so, the largest contributor -- as a scientist, I'm simply telling you, the largest contributor actually is the manufacturing, testing, open detonation of old rocket motors and the whole thing.

Just to say there would be no impact -- this is a negative deck. We've all seen negative decks. They go through and check off negative deck. Negative deck. Negative deck. This isn't an honest -- this isn't a scientific discussion. I'm aware of what NEIR is. I've dealt with them for 25 years.

Thanks.

MR. BONNER: Thank you. Jimmy Spearow.

JIMMY SPEAROW: Thank you. The -- the --

UNIDENTIFIED SPEAKER: Take a deep breath, Jimmy.

JIMMY SPEAROW: The PEIS underplays many environmental effects of the BMDS. The Ballistic Missile -- I'm sorry. The Ballistic Missile Defense System PEIS does not address several of my scoping comments to start with and does not adequately address several risks, including exposure to increased levels of toxic pollutants from a dramatic increase of missile launches.

As we know, the -- the perchlorates are used in the self-propellants in the formation of a key thyroid hormone which are critical for growth and development of fetuses and children. The PEIS proposes to allow over thirty-fold higher levels of perchlorate at 200 parts per billion than proposed by the State of California, which is six parts per billion. Thus, many rocket launches will inject chemicals including aluminum oxide, hydrogen chloride and hydrochloric acid directly into the upper atmosphere, thereby depleting the ozone.

The PEIS does not address the direct injection of the chemicals high into the atmosphere. Secondly, the BMDS PEIS underestimates the risk of health and safety of BMDS missiles accidentally shooting down civilian and/or friendly military aircraft.

BMDS has failed to mention the U.S. missile systems have a history of accidentally shooting down aircraft.

Consider the U.S. has seen the Pac-3 missiles, which are -- which are in the PEIS, actually shot down several U.S. and allied jets -- two or three in this case of -- I'm sorry -- in two of the cases of the recent invasion of Iraq. There is also Flight TWA 800. And even though several people saw streaks going up toward it, the people that saw it were never allowed to testify.

The -- the point is that the activation of the BMDS risk accidentally shooting down civilian airliners is not even considered in the BMDS. It's a risk to health and safety. While the BMDS states that warning will be provided to enable time to clear the air space, it's highly doubtful that such time would be allowed in such an emergency.

Also, the PEIS underestimates the effects of space to reach from high altitude midcourse missile intercepts in the destruction of satellites, particularly at high altitude.

Furthermore, while the PEIS considers testing the BMDS on targets of opportunity, no mention is of the space debris resulting from U.S. targets of opportunity or other nations' targets of opportunity. The environmental consequences of mini rocket launches needed to deploy and maintain space-based interceptors has not been adequately considered, nor has its environmental consequences of the

fuel. They talk about having all of the -- these -- in other words, in Option 2, they have many different interceptors in space that would have a reduced environmental consequence. But there's no consideration you have to launch all of those missiles in the place to get there.

Also, will the space-based satellites use nuclear power sources? Will any BMDS interceptors use nuclear warheads? This was not clearly defined. This is unsatisfactory. The BMDS does not include a real No Action Alternative. Such an alternative does not include further development and testing and deployment of these weapon systems needs to be considered and included in the PEIS. The PEIS does not consider a No Action Alternative at all. In other words, something that would involve rejoining the UN and -- and many other nations of the world in order to enhance security through treaties and arms control, sovereign approaches; i.e., approaches that provided us with long-term security to date.

Also, the PEIS, has not considered any -- has not considered any radioactive follow-up from interceptive missiles. The effects of war are not excluded for the analysis of NEPA. However, the proposed BMDS action is likely to promote a worldwide weapons of mass destruction arms race and force other nations to prepare a massive

retaliation against the U.S., should war ensue.

Since the proposed BMDS is very likely to cause a massive arms race, the environmental consequences of a resulting war with nuclear and other weapons of mass destruction should not be ignored.

The PEIS needs to consider the environmental effects that follow up from interceptive weapons of mass destruction, as well as effects of weapons of mass destruction the BMDS fails to intercept. This needs to be considered relative to a true No Action Alternative.

Thank you.

MR. BONNER: Pallo Deftereos.

PALLO DEFTEREOS: I'm Pallo Deftereos, Chairman of the Sacramento Committee for Nuclear Arms Control. I oppose national missile defense, not primarily because it is a near-term threat to our environment but because it threatens human survival.

My concerns are shared by many senior military officers, Nobel Laureate scientists and diplomats. I've been collecting literature on the nuclear weapons issue for over 20 years. Fred Takikowa of my committee will give you an envelope containing a sample of my collected literature. I gave your agency some of the same articles at last year's hearing.

My combined total of employment with the State and

Federal government was almost 40 years. So I know how government works. My differences are not with the MDA representatives who are here tonight. They are instead with Federal decision-makers at a far higher level than these gentlemen.

Thank you.

MR. BONNER: Thank you. Dan Bacher. Do you want to use the hand-held mic, Dan?

DAN BACHER: Does not matter. Where is that? Yeah.

Hi. I'm Dan Bacher, Central American Action Committee member and long-time environmental and peace activist. And I suggest an Alternative Number 4, which means scrap the entire PEIS and the whole program that they are presenting here.

This is a colossal waste of taxpayers money that could be spent on just about anything else other than this and it would be productive. There is a hundred billion dollars that have been spent and another 83 billion that are planned to be spent over the ten years if this Star Wars goes into effect.

The crazy thing about this is there is no imminent threat of weapons of mass destruction or space weapons at least on Earth. I have three questions that I'd like included in the comment period of the document.

Number 1, are we afraid of the zany folks from

Zetaraticuli from launching ballistic missiles at Washington, D.C.? Are we terrified of the peaceful and highly evolved inhabitants of Europa from launching WMD's at New York? Number 3, are we afraid of the wonderful civilization of the third planet from Orion launching a massive terrorist attack here on us in Sacramento? No. I don't think so. Unless the government isn't telling us something about this.

Who are we protecting ourselves against?

Okay. What I think that -- a better thing than calling this all of the acronyms that have been given out here on this wonderful PowerPoint presentation, I think it could be summed up as "Lost in Space."

The people that came up with the Star Wars technologies whole concept are out of their minds. This is the ultimate corporate welfare project.

You know, I -- I'd like to conclude with the fact that we -- we need to get rid of this whole Star Wars project and the PEIS and everything else and get the weapons contractors off welfare.

And when I've been out demonstrating I get this stuff from people, "Why don't you get a job?" Well, I've had a job for years. You know, I've been employed the whole time. What I'd like to say to the people that are proposing Star Wars and the Missile Defense System is to

get a job, weapons contractors.

MR. BONNER: Thank you, Dan. Bill Durston.

BILL DURSTON: Dan is a hard act to follow. Anyway, turning some of the comments that have already been made relating back to the Environmental Impact Report, the Environmental Impact Report has to consider the chain reactions. The report on cutting down old growth Redwoods considers the effect it will have on the spotted owl. The Ballistic Missile Defense program will have effect on a lot more than just spotted owls.

It's not only a likelihood, it's a certainty that other countries will react to us developing a Ballistic Missile Defense System, however flawed it might be. And they will react likely by developing more ballistic missiles to overcome the defense system. I've seen nothing in the environmental report on this system that takes into account how other countries will react.

So the effects of the more missile launches, more rocket fuel contaminates going into the water, more depletion of the ozone are not just those of the Ballistic Missile System being described here. All of the effects of the proliferation of ballistic missiles around the world must also be considered in a serious Environmental Impact Report.

Similarly, with the weaponization of space it has

been mentioned that other countries are unlikely to be able to afford similar space-based interceptors. Well, the fact is, the U.S. cannot afford this system either. Nevertheless, it wouldn't take much money to send satellites into space to purposely explode and create space debris that would make the space-based interceptors ineffectual and would also make the communication satellites ineffectual and so on and so forth, basically, sabotage space for military and civilian use.

This should be considered quite seriously in an Environmental Impact Report on this system. I don't see any consideration of that. That would be a very simple way another country could stop the whole system.

You know the alternative. This has been alluded to. The alternative has to be considered. The alternative of land, sea, air and space-based defense systems are being considered. The alternative of a diplomacy-based defense system is not considered. In fact, diplomacy seems to be a -- a foreign concept to the current Administration.

But as we now know, UN weapons inspections work quite well to eliminate weapons of mass destruction. And similar systems could be deployed around the world, as was deployed in Iraq, and eliminated all of the weapons of mass destruction. These might not meet the needs of Congress, the President and the likes of Dick Cheney and

those with egregious economic conflicts of interest, as Dan alluded; but they would meet the needs of the American people.

Talk about showstoppers. This Ballistic Missile System is a threat to the survival of all living species on Earth. That is a very definite showstopper.

Thank you.

MR. BONNER: Thank you. Mr. Jaskowski.

HELEN JASKOWSKI: I'm not Mr. Jaskowski.

MR. BONNER: Sorry about that.

HELEN JASKOWSKI: My name is Helen Jaskowski and I live in San Pedro. I have to leave in a few minutes because we have to take a bus back to our campground.

I want to -- and Jonathan Paatrey from the Physicians for Social Responsibility will take up whatever time may be left from mine.

I am responding to the first paragraph here, the need for missile defense. In 1973 I was a Fulbright lecturer at a university in Poland. This was the Cold War. I lived behind the Iron Curtain and was sent back there several times more by the government to do teaching.

Would I have felt safer with this kind of system in place at that time with those threats? No, of course not; neither I, nor the people I lived among in Poland, nor the people I came home to here.

This statements says this thing is needed to protect ourselves, our allies and our friends. Does not name who the allies and friends are. We have fewer and fewer of them as every day passes. And this system will destroy any that are remaining.

MR. BONNER: Dorothy Houston.

DOROTHY HOUSTON: My name is Dorothy. I live in Los Angeles. I'm a citizen and taxpayer. Thanks, Mr. Graham, for having us here.

I'm opposed to the BMDS because the system would create a new arms race. Nuclear states will develop faster, smarter weapons and faster, smarter weapons delivery systems. It's only in videogames that the U.S. could protect itself from nuclear conflagration.

I'm opposed to the BMDS because it would undermine any effort at multi-lateral nuclear weapons disarmament and summarily wipe away any U.S. credibility in encouraging non-nuclear states to stay that way.

I'm opposed to the BMDS because it would result in a vast waste of money that could be spent on pursuing real nuclear security, such as supporting the former Soviet Republic in securing, controlling and decommissioning their nuclear materials. Even the money spent giving the Boy Scouts tours of hardware at Vandenberg Air Force Base could be used by Russian scientists and physicists to help

protect us all.

Star Wars is a dangerous, destabilized and expensive fantasy. Spend my tax dollars on something that will protect me, my family and amphibians and the Boy Scouts from ultimate environmental issue nuclear holocaust.

MR. BONNER: Jim Lingburg.

JIM LINGBURG: Thank you. Hi. I'm Jim Lingburg. I'm the Legislative Advocate for the Friends Committee on Legislation in California here in Sacramento. Thank you very much for giving me a few minutes to address you all here today. Excuse me.

Rather than extending the arms race into space is we believe that the only way to reduce the threat of war and violence is by addressing the social and material conditions under which we live, reducing those inequities that make war and terrorism attractive options. We spend twice as much on militarization as the rest of the world combined. Can we honestly say that has made us safer?

We were unable to stop 19 men with boxcutters. Since 1983 we've spent a hundred and thirty billion dollars for missile defense. The Administration wants to spend 10 billion dollars this year. We have a letter from 49 retired military generals. If you go to the Center for -- the Center For Arms Control of Non-proliferation, if you go to their website, there is a letter from 49

retired military generals asking President Bush to not spend this money on missile defense, to divert resources to protecting our ports from weapons of mass destruction that could make it into the country.

They also say U.S. technology already deployed can pinpoint the source of a ballistic missile launch. It is therefore highly unlikely any state would dare to attack the U.S. or allow a terrorist to do so from its territory with a missile armed with a weapon of mass destruction, thereby risking annihilation from a devastating U.S. retaliatory strike.

We would note that militarization consumes 50 percent of our Federal tax dollars and our best scientists. Instead of throwing money down a drain or black hole, imagine what we could do if we had a Marshall Plan for the planet. This is the only way to make the planet safer. We need constructive, not destructive, solutions.

Diplomacy, disarmament and multi-lateralism as opposed to unilateralism is the answer.

Thank you.

MR. BONNER: Darien Delu.

DARIEN DELU: I'm Darien Delu. I'm connected with the Women's International League for Peace and Freedom, the United States section. It's an honor to get to speak to this body because of the other speakers who have come

before me, who have covered so many of the critical points that have to be addressed in the Environmental Impact Statement.

We have been presented with a document with 700 pages of inadequate information and sidestepping and general ignoring of the real issues involved. Many of these have been raised already tonight and I'll try not to be too redundant.

The -- NEPA provides for consideration of environmental impacts of the MDA proposals. The MDA PEIS finds only limited environmental consequences for the two proposed alternatives. The so-called No Action Alternative creates a straw dog against which to judge the first two alternatives of the MDA.

The focus of my comments will be two-fold. First, I call for a true No Action Alternative, as have others. For example, or specifically, an alternative that goes beyond the failure to integrate anti-ballistic missile system to an alternative that rejects the individual missile defense elements of a BMD System. Secondly, I point out the unaddressed global environmental impact of an accelerated arms race. Such acceleration, as has been repeatedly pointed out this evening, is entirely predictable as a consequence of the U.S. BMD program.

Because of the devastating impacts -- political,

environmental, ecological and psychological, as well as merely environmental -- the impacts of a Ballistic Missile Defense Program of any kind, this PEIS must address a true No Action Alternative. The failure of this PEIS to include such a true No Action Alternative violates the requirements of the NEPA process. The absence of a true No Action Alternative allows the PEIS to construct a false comparison with the other alternatives underplaying the different degrees of environmental damage.

According to the PEIS, the proposed action is needed to protect the U.S. from ballistic missile threats. However, the proposal as -- as a BMDS, a Ballistic Missile Defense System in English, will result in an acceleration of the global arms race.

As others have already pointed out, in the case of China, if the U.S. implements a BMDS, other countries will feel called upon to create or increase their missile-based weapons deployment systems as well as their nuclear armament in order to prevent -- in order to present themselves as credible negotiation parties with the U.S. and protect the survivability of their weapons.

As others have already pointed out, the PEIS fails to address the chilling possibilities and associated impacts of an accelerated arms race and its increased missile testing. We're not even talking about the devastation a

war would cause.

And what about nuclear proliferation? The PEIS does not address the many environmental impacts of the entire nuclear cycle connected to nuclear proliferation. The PEIS points out NEPA excludes from consideration the environmental impact of a nuclear war or any acts of war. But as human beings, we cannot exclude that in our considerations.

MR. BONNER: Ellen Schwartz.

ELLEN SCHWARTZ: Good evening. I'm Ellen Schwartz. I'm the Co-chair of the Sacramento branch of the Women's International League for Peace and Freedom. And I thank you for the opportunity to speak here.

We know from Gulf War I and the War on Terror and the test results to date for the components of the BMDS that the surgical precision with which U.S. weapons are guided makes them excellent instruments for destroying embassies, wedding parties and a hotels full of journalists. In other words, you honored military gentlemen have trouble hitting your backsides with both hands. If you're -- there, is no way that a kinetic weapon -- is that what you call it? -- hitting a missile with an arrow is going to be able to actually hit any significant number of incoming alleged threatening missiles. You're going to have to use nukes in order to get a broad enough range of

destruction to take out any of these alleged incoming threats from Alpha Centauri.

Are you going to test them? Are you going to talk about them in the PEIS? Are you going to talk about the environmental impact of testing nuclear weapons in the atmosphere? Or are you just going to lie in the PEIS and, you know, get it installed and say later, "Oops, we have to have nuclear warheads"?

The display outside the hall finds uniformly no significant impacts from any of the phases of the BMDS. Emissions will be disbursed by the wind. It's unlikely any animals will get in the way. Of course, no satellite has ever fallen out of orbit and no rocket vehicle has ever blown up on launch so there is no danger of anything ever going wrong.

Even on your own terms without considering the environmental impact of forcing China, Korea, Iran and everybody else in the world to build their own systems to protect themselves from ours, even without considering the possibility that any of these countries including us might use these systems, the BMDS is a disaster waiting to happen. Every weapon built, sited, tested or even decommissioned is a potential disaster.

Your three alternatives assume a program that is going to be implemented whether we do whatever we say

here. And the PEIS and this hearing is nothing than a legal formality. You have no true No Action Alternative; only build it together or build it a little bit at a time and don't test it together.

I'm a little offended that all you want to hear about is the environmental impact of this system; whereas the presentation talks about how we'll all be not safe if we don't build it. If the safety of our country from our alleged enemies is on the table, then so is the impact of causing a war.

What you should do in your own terms is to consider a true No Action Alternative, which is an analysis of the relative emissions of greenhouse gasses and space debris and toxic chemicals and radiation caused by either (A), blowing things up or (B), pursuing broader implementations of existing treaties, such as the Nuclear Non-proliferation Treaty and the Anti-Ballistic Missile Treaty, which would not produce any greenhouse gasses, any space debris and would not blind any animal or destroy any life on Earth.

Thank you.

MR. BONNER: Thank you. Marjorie Boehm.

MARJORIE BOEHM: I'm another speaker for the Women's International League.

UNIDENTIFIED SPEAKER: The microphone.

MARJORIE BOEHM: I'm another speaker for the Women's International League and I have the honor of reading the statement that was sent to us by our president, Sandra Silver.

The Women's International League is a 90-year-old-non-governmental organization that has worked tirelessly since its inception to put an end to war. We have supported the development of international institutions and international law and non-violent methods of conflict resolution that together could facilitate the coexistence of diverse nations and peoples on this planet. The MDA Draft PEIS seeks to answer to detrimental environmental effects of three alternative development plans.

We have found the answers disturbingly incomplete. We have also considered all three alternatives presented and have concluded that it would be dangerous and indeed disastrous for the future of our nation to proceed with any of them. It's impossible to comment on all of the details but we will be submitting additional comments.

First, we are convinced that Alternative 2, which includes the development of space-based interceptors, is completely unacceptable. We will submit additional comments on both the issue of debris from experiments with space-based weapons and on the development of laser

weapons.

I'm skipping a little but -- and we have extra copies of this report. So we'll be glad to share them with you. We believe Alternative 1, which does not include space-based weapons and Alternative 3, which is unclear on this point, are also unacceptable.

Even from a solely environmental viewpoint, we're concerned about the adverse effects in all of the resource areas discussed in the PEIS, including hazardous waste, legal restraint, decommission, destruction of the ozone layer, global warming and rocket fuel solution.

We also wonder why this expensive and almost certainly unachievable missile defense program has been developed in the first place.

It does not answer to probable threat to our national security in the present or in the coming decade. It will do nothing to prevent terrorist attacks. And now there is no hostile country or group with the capability of firing intercontinental ballistic missiles at the United States.

Missile defense seems rather to be preparation for future confrontation with the only two countries really capable of threatening our current military domination or challenging us with nuclear attack. Neither China nor Russia is currently an enemy but this aggressive program may well push them into organizing allies and forces

against our own threat of global and planetary domination.

MR. BONNER: Thank you. Ali Hosseinion.

ALI HOSSEINION: I'm Ali Hosseinion. I am an American Iranian -- I'm an American Iranian and I'm really scared in this country. Because this Environmental Impact Report was really just like a third world country Environmental Impact Report. They made it. They approved it. And four locations in the United States are like this, are gathering to say and voice their opinion. That is really a shame. Hundreds of billions of dollars spending and then only handful are here with no budget to look at it and no time to oppose it.

Shame on me. Thank you.

MR. BONNER: Jeanie Keltner.

JEANIE KELTNER: I'm Jeanie Keltner, a Professor Emeritus of English and editor of the progressive paper here in town.

I'm sad to say I'm speaking with a deep sense of futility today calling for a true No Action Alternative. A deep sense of futility because I don't believe this multi-billion dollar system can be stopped even by the passionate, eloquent informed people in this room who have come here on our own dime and our own time and spent many dimes and many hours working for peace and better ways to reconcile differences than the ones we see presented

tonight.

Too much money is going to too powerful entities to be stopped by any citizen's group I'm sad to say. But what has really struck me as we speak today is that we're really speaking such different languages. How I wish that we could communicate with each other because the PowerPoint presentation was so far, so different from the words that are being spoken here today in the room.

And how I believe that we are here all working for what we conceive of as the greater good. And it is so tragic that as we face the enormous challenge of global warming and peak oil and ozone depletion that we're going to waste the human capital and the financial capital on this poisonous boondoggle that doesn't even work.

You know, we in Sacramento are surrounded by the toxic mess the Department of Defense and its contractors have left behind. And the U.S. Government has even stopped cleaning up. The corporations long ago stopped cleaning up. The U.S. Government has stopped cleaning up. And I am certain that mothers have sat by the bedside of dying children because of the chemicals those children have ingested, the toxic cocktails. And that is not worth anything.

So I just wish it could be different.

MR. BONNER: Jonathan Paatrey. Jonathan, you've got

two extra minutes given by Ms. Jaskowski.

JONATHAN PAATREY: First, I would like to --

MR. BONNER: Can you turn it on?

JONATHAN PAATREY: Is it off? All right. Thank you.

First, I'd like to thank you, Colonel Graham and Mr. Bonner and Ms. Shaver and Mr. Duke for coming out here and -- and presenting your material and then hearing what the public has to share.

My comments are, I hope, going to be very specific and germane to the PEIS. One of the things I want to point out is that the -- our organization I represent is the Physicians for Social Responsibility in Los Angeles. We have about 5,000 members in Southern california. And we have actually worked with Lenny Segal and I believe you've heard his oral testimony as well as written documents regarding the perchlorate and the lack of information that is present in the PEIS.

Most notably, I would like to point out that the timeline of potentially releasing the final document but two weeks after the oral testimony, as well as what anyone else could offer in writing and -- or even six weeks later into -- in the end of January of '05 strikes me that you very well may not take too seriously what we have to say.

I would strongly suggest that you factor a time when you can actually take into account the things that the

public are suggesting.

I would like to offer some language for other alternatives which would entail a great deal of work on your part in the MDA office but I think it is absolutely necessary.

You're clearly aware of the political decisions that led to the formation of missile defenses, in general, coming out of a decision politically that deterrents were no longer sufficient. I feel that this Administration in making that determination is mistaken. But in addition to that, we haven't tethered out the differences in this document between strategic defense defenses against long-range missiles and those of an -- in a theater defenses. And all previous administrations had kept these two missile defenses segregated. And this Administration has blended the two. And I think to the detriment because theater defenses have actually a promising future, unlike strategic defenses.

Theater defenses can protect troops in the field. Theater defenses can protect cities from attack, overseas especially. And they have actually enjoyed some limited success both in the field of testing as well as in the battlefield and also enjoys bipartisan support.

There is actually a realistic threat. There are short-range and medium-range missiles that could actually

be fired in hostility at American targets or those allies; unlike the strategic long-range missiles which do not really have a basis in reality.

And in addition, theater defenses have a realistic success because the boost phase of a missile is relatively slow and even the descent of a short-range, medium-range missile is much slower than that of the strategic missile, which could be traveling at 10 kilometers per second, which makes it very unlikely to hit.

The alternative, it may be politically impossible for you to do this, but I think you should try to have another alternative which would simply be to keep the -- this is probably the presidential candidate John Kerry's position on these matters -- would be to move ahead on theater defenses but to maintain the strategic weapons that the missile defense is -- against long-range missiles to be held in research and development stage. And -- and that would be my suggestion for a true alternative.

The other thing I want to bring up is in regards to in the PEIS there is some statements in the effect that some of the space-based interceptors would be placed in geosynchronous orbit, which I believe is some 24,000 kilometers from Earth. To actually get a weapon from 24,000 kilometers out to what would be a low-Earth orbit or even a lower trajectory of a missile within 20 minutes

or half hour and do so accurately and to hit the missile is fantasy. And therefore I think the PEIS mischaracterizes any weapon that would be placed in geosynchronous orbit as being an anti-missile weapon. It should simply not be listed as a possibility. That would be -- well, you would be deploying an ASAT -- an anti-satellite weapon. And you should go through the process of actually fielding that before the public and have -- and take your hits for that if, indeed, you're doing that.

The same with the Airborne Laser. There is a very good probability that an Airborne Laser would never work in shooting down a missile in the boost phase and all tests indicate that. But it could be highly effective in a directed energy targeting on Earth for terrestrial targets. And you should be honest about what that weapon might also be used for. It would be helpful to actually not mask the true purposes of some of these weapons.

I believe there needs to be more hearings. The PEIS is insufficient in dealing with cumulative effects, especially in Southern California, as so many of our local contractors are working on the weapons systems. We're bearing the brunt of our environmental impacts of the laser weapon development and many of the rocket launches and the rockets that are being assembled for those

launches to launch these 515 launches that may take place over the next 10 years.

I also suggest that you get testimony from the National Recognizance Office, if you have not done so. I'm sure there are considerable concerns about military recognizance assets being false -- being harmed by space debris and --

MR. BONNER: Finish up.

JONATHAN PAATREY: Yes. Last but not least, I would also suggest that you conduct a space debris analysis, as you have sited in the PEIS, that there may be intercepts as high a 400 kilometers. That either you do testing at 400 kilometers, which is ill-advised because of the debris problem, but how would you know if the weapons work unless you conduct the tests? Or you should actually assume that the weapons won't work because you cannot conduct the tests at 400 kilometers above.

Thank you very much.

MR. BONNER: Michael Monasky.

MICHAEL MONASKY: So this is a show, as we have showstoppers. I'm confused. Well, actually, I -- I was confused by the glossary. It's five pages long and single spaced. And I haven't started yet.

The New York Times magazine two days ago asked Wlodzimierz Cimoszewicz, Poland's Foreign Minister to the

United States about Polish defense minister, Jerzy Szmajdzinski who recently announced plans to pull all 2500 Polish troops from Iraq next year. Cimoszewicz answered, "It's not true. Our minister of defense mentioned that we would like to end our mission at the end of 2005 but that is not the official position of the government." But when the Times asked Cimoszewics if he had met with the families of the 13 Polish soldiers who died in Iraq, Foreign Minister had replied, "No. I have not." The Polish government was officially represented by the minister of defense.

Which begs the question: Has the defense minister been demoted to coroner/chaplain or how many dead Poles does it take to end the U.S. war in Iraq? Furthermore, Polish Foreign Minister Cimoszewics confirmed the Times figure that 70 percent of Polish people oppose the U.S. war in Iraq.

What are we afraid of? The Polish public opinion? The so-called insurgent Iraqis taking up arms against U.S. corporate mercenaries like Cal F. Brown and Root and Halliburton? Ari Fleischer's so-called Operation Iraqi Liberation? That was the original term for this attack, O-I-L. Serves to liberate the resources under those inconvenient civilians impeding corporate access.

The Cold War is over but this fact does not deter the

Bush crime syndicate from heating things up. There is no peace dividend as it and any surplus saved in the 90's has been spent since the start of the millennium. The world is a decidedly more dangerous place because the Pentagon has run amuck spending half of our income taxes while mortgaging debt so far as our great grandchildren so it can build so-called "kill vehicles."

Meanwhile, the Pentagon mocks our democracy. It plans, tests, builds and imposes terrible weapons of mass destruction. The Pentagon goes through the motions pretending concern about the environment, holding meetings in far away places like Alaska, Hawaii, where 61 people appear; 15 speak forth; and 7 provide written comments representing 280 million U.S. citizens.

Even the congressional "Millionaire Boys Club" does not feign that kind of representative democracy.

The Pentagon does not even care about the speaking and writing concerned citizens. Its Notice of Intent in the Federal Register states the weapons system in question will be used, quote, To defend the forces and territories of the U.S. allies and friends against all classes of ballistic missiles threats in all phases of flights. Which, I suppose, makes the people of the U.S. potential collateral damage.

I imagine the purveyors of the Pentagon portfolio

are like the characters in the Beatle’s satirical song entitled, "Piggies": Lying, conniving, consuming everything in sight. They never see their evil behavior inflict pain and suffering upon other beings and upon the world. And to get their attention and change their behavior, what they need is a damn good whacking. Of course, the song is referring to spanking but the Pentagon and spenders can measure its whacking in body counts.

Here in California we analyze public projects and hold them to the test of the California Environmental Quality Act of 1970. When the Pentagon wanted to build a biological nuclear and chemical testing, manufacturing and storage facility at McClellan, UC Davis and Rancho Saco, the community successfully challenged and stopped the bid even before it could be tested by CEQA. The community saw the proverbial writing on the wall. The plan was analyzed. We found it wanting.

MR. BONNER: 30 seconds.

MICHAEL MONASKY: It amazes me -- I have to make a comment, since you've decided to interrupt me here. I speak before city councils and boards of supervisors and they sit -- they sit up until 1:00 in the morning listening to people like me talk who prepare comments. I think it's extremely rude for you to stand there and time

us when we've prepared our comments and we've thought this through.

You might have come from Fairfax, Virginia but you know, I'm sorry if I cut into your tee time or anything. So I'm going to finish. I have two more pages. But I'd appreciate it if you would stop interrupting my comments and those others who have worked all day, like I did, and came here.

MR. BONNER: You're cutting in to the time of the others. There are ten other speakers.

MICHAEL MONASKY: No. No. We're cutting into your time. This is not the time of others. This is the others. We are -- are the others. We are the people and we're speaking here, sir. Let me finish without interruption.

Did I get to the spanking?

The body counts. Yes. Thank you. And I talked about the California Environmental Quality Act, of which I think is great -- well, I think it's good to have an Environmental Quality Act. It's weak but nonetheless it's there. Let me pick up where I was at. Here.

Anyway, the community saw the writing on the wall. The plan was analyzed and it was dropped but this -- the same is true of defending BM's. This PEIS reads like a negative declaration.

In case you have not heard, the Cold War is over. This is reason enough for the No Project Alternative CEQA style. It's time for demilitarizing the Pentagon. I'm partial to Helen Caldecott's suggestion that it be converted back to its original design as a hospital.

I recommend we just skip the testing, manufacture and storage steps for these weapons systems that are referred to in this EIS and cut to the quick and decommission them all. Take out their fuses and timers and igniters and hire clever chemists to convert their horrible toxins to safe use.

Further, since adults seem to muck things up in the State Department, we should pay and support a coterie of children as ambassadors of peace and reconciliation to all countries on Earth. No more foreign aide. No more foreign debt. The kids will figure it out from there. The spanking should continue upon Pentagon contractors until they change their behaviors. Meanwhile, rescind all Pentagon weapons contracts. No more bucks for bombs. The reason why the Pentagon thinks it needs these weapons systems is because the United States of America has neither learned how not to over consume the planet's resources or stop exploiting human labor. We must become men and women of conscience who believe in and practice trust and respect for one another.

The No Project Alternative, as in CEQA spares us and our planet's ecology while allowing our energies to be spent on truly productive human endeavors.

No showstoppers, eh? So this is a show. This PEIS is a non-responsive negative declaration.

Thank you very much for your time.

MR. BONNER: Just to clarify, we're willing to stay here as long as you like.

UNIDENTIFIED SPEAKER: We came here on our own time. We payed our own fare to get here. I came from far away. Many came from far away. You are paid to be here. You got your fair pay to be here. You're put up by the government. We are not. Therefore, I think you should listen to us.

MR. BONNER: That is the purpose of this meeting. The reason for setting the time limits is not to restrict comments. The reason for setting the time is to respect your time and the time we have here. We're willing to spend as much time as you want to get your comments out. That is the reason behind the three minutes.

Leonard Fisher.

LEONARD FISHER: I'm Dr. Leonard Fisher, retired faculty member of medicine at UCLA and volunteer physician at the LA Free Clinic and a member of Physicians for Social Responsibility. I'm one of the groups that drove

through the rainstorm this morning to get up here so we could express our concerns about what is going on.

I'm going to limit it to the problems related to ground-based interceptors. The most tested but still woefully ill-performing technology to develop to thwart long-range ballistic missile attack is out of the midcourse interceptor. This weapons system is designed to intercept enemy missiles in space from ground platforms in Fort Greely, Alaska, Vandenberg Air Force Base in Southern California. The chemicals used in solid rocket propellant that would be used to launch the intercept missiles, the test missiles and especially the booster rockets that place related detection communication satellites in space would all use ammonium perchlorates as the oxidizing agent in the rocket fuel. The fuel would also contain highly toxic hydrazine compounds and nitrogen oxide.

In the news of late, the developmental toxin perchlorate has been found in many of our nation's drinking water sources. This chemical inhibits thyroid hormone creation and release. In low doses, perchlorate is presumed to decrease the intelligence potential of a developing fetus. In cases of more severe exposure, can cause frank retardation.

Additionally, once combusted and exposed to air moisture, perchlorates create hydrochloric acid, more

commonly known as "acid rain."

Further, rocket launches deliver hydrochloric acid in the upper atmosphere, which, in turn, chemically interact with the protective ozone layer. It is therefore fair to assume that an increase in rocket launches may correspondingly bring about additional cases of skin cancer.

Rocket fuel needs to be continually replenished. The disposal of solid rocket propellant through washing out, propelling or open burning, open detonation are some of the major sources of perchlorate contamination across the country.

None of these perchlorate-related issues are adequately addressed in the PEIS. I'd like to add one further comment regarding the meetings that have been held. Southern California is bearing a disproportionate impact of missile defense development and its effects on the environment. The midcourse interceptor is being tested and deployed at Vandenberg Air Force Base in Santa Barbara County.

The Airborne Laser is being tested at Edwards Air Force Base in Los Angeles County. The space-based and Airborne Lasers are being developed by Northrop Grumman in the South Bay and San Juan Capistrano. Lockheed Martin, Boeing and Raytheon are deeply involved in developing the

midcourse interceptors and other systems.

At a minimum, there should be additional hearings near the areas most effected by missile defense developing. There should also be an environmental health evaluation concerning cumulative impacts for military production, testing and deployment of missile defense systems compounded on top of past military use.

This evaluation should be done with an eye on disproportionate impacts on low-income communities of color.

Thank you.

MR. BONNER: Philip Coyle.

PHILIP COYLE: I'm Philip Coyle. I'm also from Los Angeles. The environmental process --

MR. BONNER: Raise the mic.

PHILIP COYLE: Is this better? I'm Philip Coyle. I'm also from Los Angeles. The environmental process described in this PEIS is not believable or trustworthy because the statement read by Mr. Duke tonight is already not being followed. Mr. Duke said if testing failed to show the system worked, the system would not go forward. But as we know, the system is already being deployed even though it has no demonstrative capability to work under realistic conditions.

To take a different example, the PEIS says and, I

quote, The Airborne Laser is currently the only -- emphasize only -- proposed BMDS element with a weapon using an air platform, closed quotes. However, the PEIS does not discuss another proposed BMDS element that would use air platforms; namely, interceptors fired from aircraft.

With respect to the No Action Alternative already mentioned by others, it does not describe a scenario where no action is taken. Rather, it describes a system where the Missile Defense Agency would continue existing development and deployment unabated under the No Action Alternative. And I quote the PEIS here, Individual systems would continue to be tested but would not be subjected to system integration tests, closed quotes.

This is hardly no action and allows for indeterminate missile defense program since -- to go back to quoting the PEIS, There are currently no final fixed architectures and no set operational requirements for the proposed BMDS, closed quotes.

Thus, even if MDA agreed to the No Action Alternative, it would not find its actions constrained for the foreseeable future.

And, finally, with respect to space-based interceptors, the PEIS is silent about the fact that missile defense would, for the first time, weaponize

space. While space is certainly militarized, it's not yet weaponized; that is, with attack weapons in space and with the chain reaction of a new arms race in space.

The PEIS does not adequately address the environmental impacts of the consequences of placing strike weapons in space.

Thank you.

MR. BONNER: Lara Morrison.

LARA MORRISON: I'm here from Los Angeles and my background is in bioethics and environmental science. And I feel like the PEIS provides an inadequate assessment of the environmental impacts. It does not allow the reader to compare the magnitude of the potential impacts or the degree of risks involved with the alternatives and with the elements of testing, deployment or not acting.

The proposed system will promote a false sense of security while preempting the use of resources to address real threats, global warming and peak oil.

According to the report on winning the oil end game from the Rocky Mountain Institute and the Pentagon, the U.S. could eliminate our dependance on oil by investing a hundred and eighty billion over ten years.

Dennis Hayes advocates investing 30 billion in implementing solar power over five years as a way of addressing energy problems and reducing the chances of

global warming.

These two proposals would greatly improve our security and the health of the planet for less money than is planned for the Ballistic Missile Defense System, which is between 800 and 1200 billion dollars over 15 years.

Also, this impact assessment does not address the potential threats of these weapons falling into the hands of terrorists. And I think that that is really a significant issue. If we don't develop, they cannot fall into the hands of terrorists. If we do develop them, they can. And particularly since the scope of this project is to have different elements deployed throughout the world, and we can't be on top of every local deployment area all of the time, it greatly increases the chance that something like that could happen.

Thank you.

MR. BONNER: Stephen Gonzalez.

STEPHEN GONZALEZ: How you all doing? As you said, my name is Stephen Gonzalez. I'm a resident of planet Earth. I think that is really about all that needs to be said about where I live.

As the subject matter of the defense system covers the whole planet, as is implied by the neat charts and graphs, it does not -- that is kind of a given -- what I find amazing is that the biggest issue is that they've

seen the need to integrate a system against a localized threat. Yet the threats to the implementation of the system are not taken holistically; i.e., well, we'll worry about a site-by-site assessment of the environmental impact threat. If you're going to impact the water in one place, it's going to impact the water somewhere else, too. Shouldn't we be tying the threats to the system showstoppers -- which I still don't know what they are? What would -- I -- I'd like to know what would have given these people a red flag to say maybe we shouldn't do this? It's not the depletion of the environment or public health or pissing people off around the world. Those aren't showstoppers. I'm scared to know what the showstoppers are to them. Must be pretty major, like the whole atmosphere lighting on fire. Is that a showstopper?

You know, I mean, laughter is good. You know, I wish I -- it was that funny actually. I have just -- I want to bring to the attention of everyone here that it's good we're here but we need to talk to other people. Someone brought up the issue of communication. We're not talking about the same issues of defense. What is a defense to us? What is a threat to our safety? I'm a lot more concerned right now about dying of asthma than I am of Osama Bin laden. I can feel my lungs collapsing every day. I can smell it in my water. I can't see the

mountains. And that was not brought by a terrorist. None of those effects were brought about by terrorists or weapons of mass destruction.

You know, these -- the very process by which we're protecting ourselves are creating the greatest threats to our security. At some point that has to be evaluated. This whole system is really about a very specific threat from a very specific place. This is about choosing a style of conflict, choosing a path of conflict that they've decided is the best way they can win of all of the scenarios of direct conflict engagement or technological engagement. They've decided this is the best way.

You know, I -- I'd like to think there isn't a conflict that is predetermined. I would like to think there is still some hope for diplomacy and such that they've got it planned out we're going to eventually fight somebody. I'll leave you to wonder who.

Don't be afraid to talk to people.

MR. BONNER: Stella Levy.

STELLA LEVY: Thank you to everyone who has spoken so far. I think it's been -- I have learned so much and I feel like I really understand a lot more than I did when I came in. There is not very much really that I can add to a lot of the things that have been said because I don't have the particular expertise.

I'm a local attorney concerned with human rights and peace. And so one thing I thought I might address is something that was alluded to by several of the speakers and that has to do with the process we're involved in here.

As an attorney, that is something we're always concerned about is process. At first when I first heard about the hearing and when I came here and saw all of the nice exhibits you had put up, my first impulse was this is really cool -- you know, this is really nice and how nice we've all been invited. But now I don't think so anymore because I'm noticing that there were only four locations at all where public testimony has been invited: Virginia, Sacramento, California, Hawaii and Alaska. That seems to me to be not nearly enough public input. That point has already been made.

I would like to talk about Exhibit ES-3, which is part of the Executive Summary. If you want to go along with me, that exhibit shows the effected environment. This is about environment that we're talking about here today. I looked at that to see what the affected environment was. All of the environment that can be affected is divided into nine biomes, as well a broad ocean area and the atmosphere. I went through that and I saw the following. I saw that we're talking about the

Arctic regions, North Atlantic Ocean, Pacific Ocean, Alaska, Canada and Greenland. Then some more Arctic regions and also Alaska, deciduous forest and Eastern and North Western U.S. and Europe, Chaparral. That is California Coast, Mediterranean from the Alps to the Sahara Desert, from the Atlantic Ocean to the Caspian Sea. This is a lot of area here. And these are areas that are labeled as "affected areas." Oh, the Grasslands. That is the whole prairie of the Midwest. The desert. Oh, the arid Southwest. New Mexico, Arizona, Utah and the Rocky Mountains, as well as the Alps, Pacific Equatorial Islands, which I don't know. Maybe that is why we're going to be in Hawaii. Northern -- you've got to turn the page. Northern Australia. And then how about the broad ocean area. That has no particular latitudinal range and that's the Pacific, Atlantic and Indian Ocean. And then the really big one, the atmosphere, which is the atmosphere which envelops the entire earth.

That looks to me like a global environmental impact. And it seems to me only fair and some kind of rule that I think is codified in lots of different places that the people that are effected by legislation and -- and programs get to talk about it, get to respond.

Well, that is going to be a lot more than the people in the U.S. Even if you say four hearings is enough in

the U.S. --

UNIDENTIFIED SPEAKER: Who said that?

STELLA LEVY: Who said it? Nobody. I did not say it. Even if you do, this is a global environmental impact, this Star Wars Program. And, therefore, I'm not impressed with the hearing anymore. I think four is completely minimal. And so I would like to take the remainder of the time, if you would allow me, to make some suggestions of things that maybe other people might want to add, things that we might be able to do and do a little organizing here; which is, first of all, I think it would be entirely appropriate if you -- anybody who knows anyone and has connections, friends on legislation, which I'm a big supporter, lawsuits -- I think some lawsuits are called for for the reasons that were explained, which is the Environmental Impact Report is really inadequate and does not -- does not meet basic legal requirements.

I think that would be a very good thing to do. You should get ready for that and -- Colonel -- and another thing too is there are a number of people here representing different organizations, Physicians for Social Responsibility, FCL has -- there is also Friends Committee on National Legislation, different groups and so forth. Different groups. I think really we can get the word out through our emails and so forth about this.

And I'm also concerned about contacts in Europe for those like WILPF, for instance, which is an international organization or any international organization, Greenpeace, whatever, that you belong to because I think that people in Europe, Australia and so forth have a right to know about this and to have the same information that we have. And people may have other ideas.

Now, just a little personal note here. My son lives in Southern Switzerland in the Canton of Tacino. He married a woman who is teaching. I'm going to let them know. I saw the Alps are in here. They're in the southern Alps. And I know that when I've gone to visit them, I can tell you those "peace" flags are hanging all over the place. People there really care about peace. They were part of a demonstration in Milan that was humongous. And I think there would be a lot of concern and there should be a lot of concern.

I really think it's unfair to put a Star Wars system into place and not allow people who will be affected to weigh in on that matter.

And I guess my final suggestion would be to vote for change of Administration.

MR. BONNER: Byron Diel.

BYRON DIEL: I'm Byron Diel. I'm a paramedic and music activist. I'm representing Peace Fresno and the

band, Superfluid Helium 3. I'm going to address my comments given the possibility, however unlikely, that the system would actually work and that it's not just a big pork barrel corporate welfare project. Let's leave that large probability temporarily aside.

As the Bush doctrine of pre-emptive war required a concrete demonstration -- case-in-point being the invasion of Iraq -- the breaking of the ABM Treaty and the consequential bringing of the real war into the theater of space also requires a concrete example of which I believe Alternative 2 to be the -- the prototype.

And while I'm not generally a betting man, I would speculate that Alternative 2 is a foregone conclusion and that we're currently engaged in a process of a pseudo-imitation democracy and pacification of the public.

Alternative 2, I believe, to be a Trojan horse of sorts, given the facts the openly stated intentions of the authors of the project for the New American Century work and the Vision for 2020 and other similar documents are to create full spectrum dominance; first, by negating the threat of deterrence and increasing the perceived virility of our own nuclear arsenal by illuminating the threats of being shot back at.

Then to move on by actually creating space-based offensive weaponry and then to deny access to space for

other nations. The threshold being crossed by Option 2 is a veritable Pandora's Box, moving the militarization of space from the purely informational level to actual weaponization.

And the true environmental impact of such a threshold of crossing, I believe, must be examined on a multi-generational basis, given the dangerous president being set.

That is it.

MR. BONNER: Michael Comer.

MICHAEL COMER: I'd like to use this one if I could. Well, I apologize for what could be considered inappropriate attire. I came straight from work.

My name is Michael Comer. I live in Carmichael. I'm -- in the interest of full disclosure I am a member of the Sacramento Area Peace Action but I'm not here speaking as an official representative of that body.

First of all, I'd like to point out that there is a serious misnaming of this project, as far as it being missile defense. Missile defense is actually the linchpin of an offensive first strike capability.

I find it curious that George Bush has ordered the deployment of this system without comprehensive testing. Perhaps the reason is that the system would not likely pass that testing. I think if you talk about the missile

base system, it's really helpful if you have -- what do you call it? -- a transponder or some kind of a beacon in the target you're trying to hit.

So in all likelihood, the missile-based system will fail or at least be considered to be inoperative, which means it would be required to move on to the next phase, which I heard referred to -- basically the character of that next phase would be a satellite network surrounding the Earth. These satellites would be a base for laser weaponry. It has to be considered what would be the power source that could power a laser that could be strong enough to take out a missile or a land-based target. That would be nuclear power.

So if you want to consider environmental impact, we're going to have launches of missiles with nuclear materials aboard. If those missiles fail, we'll have nuclear material raining back on us. If a satellite is successfully launched and it falls out of orbit, it will be bringing back to Earth nuclear materials. I have not heard any of these issues addressed in the Environmental Impact Report.

I actually -- I think I pretty much have no more to say than that.

Thank you very much.

MR. BONNER: Winnie Detwieler.

WINNIE DETWIELER: My name is Winnie Detwieler. I'm here on behalf of Sacramento Area Peace Action and our 4,000 plus supporters, both to comment -- both to comment on the PEIS and to register a complaint with the manner --

MR. BONNER: Let me turn this off. I can get the other one for you.

WINNIE DETWIELER: Okay. I'm here on behalf of Sacramento Area Peace Action and our 4,000 plus supporters here, both to comment on the PEIS and register a complaint in which the manner in which the hearing has been scheduled.

There's been no widespread publicity in California that we're aware of regarding this hearing today in Sacramento. Is this some sort of the stealth strategy to limit public input on such critical issues. The question is: Can the Draft PEIS be legitimate if there is not adequate notice of the document in the hearings on this matter?

What is most disturbing, however, is that the current Administration is forging ahead with components of the first two interceptors for the BMDS, making a mockery of these hearings. It's even more perplexing that the interceptors were just installed and had not been tested in the system. The tests have been continually postponed and the Pentagon's Chief Weapon Evaluator has said the

interceptors may only be capable of hitting their target about 20 percent of the time.

Why is our government spending billions of dollars in risking the beginning of a nuclear arms race on a so-called missile shield with such an abysmal record?

The greatest danger we face is not some intercontinental ballistic missile carrying nuclear warheads to our shores; but are reigniting nuclear arms race and motivating countries that fear us to attempt illegal acquisitions of nuclear weapons. They see the technology for our Missile Defense System can also be used offensively against them. Their defense against our military superiority would be to either produce many nuclear ballistic missiles to overwhelm our 20 percent system or to use secret delivery system weapons smuggled into our country or delivered by short-range missiles launched just off shore.

Forging ahead with the missile defense system will create terrible consequences from pollution from rocket launches, space debris and accidents within the system or involving civilians.

Other groups are scheduled to testify more comprehensively on this environmental hazard. But I'm emphasizing here all people on Earth, not just Americans, face grave environmental threats from this drive to

dominate the world by dominating space.

The environmental pollution may kill us slowly if we don't do it quickly with a nuclear war. But the greatest environmental impact will be to make the entire planet more dangerous to all forms of life and we Americans more vulnerable and not safer.

Most Americans consider nuclear war unthinkable; but apparently our leaders in Congress do not. It is astounding to see the turn around on proliferation and new nuclear weapons in this Administration.

Will threatening other nations encourage them to cooperate with a non-proliferation treaty? Will the U.S. violations of the treaty persuade other nations to embrace non-proliferation? We think not.

Similarly, the abrogation of the Anti-Ballistic Missile Treaty last year by this Administration in order to pursue this fantasy missile shield will not promote international cooperation on disarmament.

We can only conclude that this rush to further develop and deploy this ill-conceived missile defense shield is driven by ideology and politics and fueled by the greed for profits from this costly boondoggle. That is what it is, a boondoggle.

The leading scientists and Nobel Prize Laureates have condemned this as irrevocable and dangerous to global

security. But this Administration rushes headlong into a hasty deployment. The term coined to characterize this drive is a "rush to failure."

In conclusion, we at Sacramento Area Peace Action condemn the Alternatives 1 and 2 with extreme threat proposed on our nation and the world. We would support the No Action Alternative if there had been a legitimate attempt at researching and weighing a true alternative of no action. Such a proposal should have encompassed a suspension of research and development, no testing and no initial deployment. It should have evaluated the cost effectiveness of vigorous pursuit of international cooperation on nuclear disarmament.

As it stands, the No Action Alternative does not meet the requirements of the National Environmental Policy Act. For this reason, we consider the Draft PEIS inadequate and insufficient for proceeding with the BMDS.

MR. BONNER: Is Rick Thomas still here?

RICK THOMAS: Yeah. Good evening, sir. Good evening ma'am. Evening all. I drove up from Fullerton, Southern California through a blizzard coming from Reno. Long story. And I've come to make some comments and I've come to ask a few questions.

I'd like to endorse most of the things I've heard here; not all, but most. I work as an addiction

counselor. I'm a Veteran. I don't -- I don't get to work with what you would calling a fun bunch of folks sometimes. But one thing I have found is that when I'm angry or when they're angry, people don't hear. I believe there is a lot of stuff here to be angry about.

One of the things I'd like to say is that one of the things that leads to addiction is family disfunction. And family disfunction often takes place with very good intentions. I'm sure these gentlemen who came here tonight to listen to us have good intentions.

Somebody asked earlier, "Where are the people?" I would guess that a lot of them are either at home unwinding from a ten-hour day, trying to make ends meet. Or they're at work at their second job in order to help the kids gets clothes so they can go to school. Yeah, I'd like to say we need more meetings about this. I'd love to see more people involved in this.

First point, addiction counselors work with overflow emotions. We can laugh or we can cry. Those are the overflow emotions. It is easy, I think, sometimes to laugh at the silliness of some of the stuff. Yeah, if we spend another 250 trillion dollars over the next decade we'll really be safe. How silly is that?

I think we can give checks to every -- everybody in the Middle East and be much safer with that amount of

money myself. Everett Dirksen -- Everett Dirksen, he had a line that said, "A million here, a million there. Pretty soon you're talking about real money."

The thing I'd like to say about that is that if this money was used for pure research, that would be fine with me. But what I see happening here is that this money goes towards an in-process research, which we've already heard from a lot a folks more articulate than I -- a Nobel Laureates, scientists, retired people -- saying this isn't going to work in the long run.

I'd also back up a point made earlier about geosynchronous orbit. I was involved throughout the 80's with a thing called High Frontier. Former Princeton professor, Gerard K. O'Neill, he said that if we would use this money that we bandy about so much like we used with NASA, the money that the government put into the NASA program throughout the 60's and 70's, created technologies and investments in the private sector $7 for every $1 invested at the Federal Government level.

I don't see how this program could create this in the private investments. I think if we talked about putting space stations up like Gerard K. O'Neill talked about that would be a much better way to get something going up there.

Lastly, a reporter once asked Mohamed Ghandi what he

thought of Western Civilization. His answer was, "I think it's a great idea." And I think it's a great idea, too. And I think if we can maybe reach across the aisle a little bit and get down to some of the more human things we're both looking for, maybe there is a way we can work this stuff out.

Nelson Mandela in his inauguration speech -- and I loved it -- he said, "I'm only running once. That is it." In his -- in his inauguration speech -- I get choked up talking about it -- he said, "After 27 years in prison I firmly believe that it is no longer man's worst that we fear the most. I firmly believe it's man's best that we fear the most."

So what I have here to ask tonight is: Where is our best in this? Where is our best in this? Can't this money be spent better for your kids, for your family? For your kids, for your family? For these people's families? My God, what are we doing? What are we doing?

Thanks for your time.

MR. BONNER: Fawn Hadley.

FAWN HADLEY: Hi. My name is Fawn Hadley. I hadn't intended on speaking tonight but I was inspired so I'm mostly going to read. I'm really glad I got to follow the gentleman I just followed.

My background is in philosophy and I work in a girls'

group home. And I see the family disfunction and how it affects those people everyday as well.

I've spent the first half of my life understanding why I self-sabotaged. I've gone to courses that have helped me to learn that I could not fix a problem with the same mind that created it, which is what Einstein said.

We have programs now that have technology that can actually change the way that we think. We have to choose that. It's a choice we have to make. But we can actually change from a victim mentality to a very powerful mentality in taking responsible for our actions. This kind of technology is also available in Israel and practiced on a regular basis all over the world through a program called Landmark Education. There is also a program called the HeartMath that teaches thinking through the heart, as opposed to strictly through the head.

There is a book that was written by a man named Goleman called Emotional Intelligence. And he -- he took his book from a program -- I can't remember if it's Life and Mind or Mind and Life. I think it's Life and Mind Institute, which is the Dalai Lama and the U.S. universities' psychology programs. They come together once a year for a week, I believe, to try to understand how we can become emotionally intelligent.

We have to look at how thinking should be our most

powerful resource. We can change how we think. I told you, I'm kind of skipping around a little bit. We have more power in our minds than a ballistic missile. Einstein, Galileo, Max Planck, to give a few examples. Taking responsibility for who we are and what we've done to people is the fastest icebreaker you'll ever find. If someone takes responsibility for something that they've -- that they've done to you, it's really hard to fault them; if they have from the heart taken responsibility. You -- it's a natural communication opener. It just automatically connects your humanness when somebody takes responsibility for doing what they've done. And I don't see that going on in our life very much, in our world very much but it's possible.

If you think I'm in a fantasy world, I'm in the same group as Max Planck and Albert Einstein, only on social issues. Let's vote an emotionally intelligent human into office. There are -- each one of us has an opportunity with every interaction we have with every person to spread that kind of integrity and communication with other people.

The programs I mentioned earlier, Landmark Education and HeartMath both have websites. There is also a man named Gregg Braden, who was first a geologist, I believe. Then he worked in the Defense System. Then he worked for

SYSCO System Computers. And he has -- for the last 12 years he's traveled around to monasteries and such and done research on our human past and what has led us to where we are today. Very interesting man. He also has a website, Gregg Braden. He also has a book called The Isaiah Effect and the last one was the God Code.

Responsibility and communication unites us. I think that is it. Hope I haven't confused anybody.

MR. BONNER: Caroline Schmidt.

CAROLINE SCHMIDT: I wasn't going to speak either but I just wanted to thank all of the people who inspired me: Pallo Deftereos and Winnie Detwieler. They've made me more aware than I ever have in my entire life of what is going on around me. Through those organizations we're going to do another nuclear forum next year, try to get the universities, try to speak to the students who are coming up.

And when I looked at her writing, I thought maybe she was the Sac Bee. Well, the Sac Bee was invited a couple of times. And Mr. Mort Salisman is going to hear from me tomorrow because I do not understand why the Sac Bee would not be here to write to get the people to know what is going on, to gather us together to get forces behind us. It needs to be done.

In a little joke on the refrigerator where a man is

standing on stage and he's asked to play a concerto. He says, "Don't make me come down there" to the audience. I'm going to go down there. I don't know how successful I will be. But maybe if everybody who lives in Sacramento will call Mr. Mort Salisman and leave messages on his machine and ask him why nobody was here and why Channel 3 and Channel 10 didn't come either.

I don't know what they're doing but I know -- I don't know. I don't think so because they checked the list. When I hear all of you speak so heartfelt and so glorious about how you feel about this country and what the right thing to do is, I'm in the right neighborhood. And whoever gets in office next time, we have to watch them like a hawk.

Thank you very much.

MR. BONNER: That is the end of the list of folks who signed up to speak. I'd like to offer an open invitation if somebody hasn't spoken and they'd like to take the opportunity.

Please, if you could give us your name and if you have an affiliation, that would be helpful.

HARRY WANG: My name is Harry Wang. And I'm a physician and a member of PSR Sacramento, Physicians for Social Responsibility. I did sign up and I guess my name got overlooked. I know it's getting late.

I believe in the separation of church and State, especially these days. I also believe in the separation of science and State. And I think this has been an issue for our current Administration because I think a lot of our science has gotten politicized in many, many different areas. I also question if the PEIS provides objective scientific information upon which to really base a decision.

I realize that there is a law passed by Congress, a mandate from the government to go ahead with the Ballistic Missile Defense System. But if you're really going to look at the science of the environmental impact, I don't think -- I don't think it's sufficient, this information provided.

I also, you know, agree with many of the comments already made about concerns about toxic pollutants, particularly perchlorate concerns about the debris in space.

But these are just -- these are agonizing times for all of us in the public. It's agonizing because of the decisions that our government is making. It's agonizing seeing how our moneys are being spent. It makes us wonder if the need of our citizens are really being looked at, whether they take priority compared to other agenda items.

For example, this year the government allocated 40

million dollars to try and come up with a new influenza vaccine. As we all know, we have a terrible shortage of influenza vaccine. It's a long process of four, five, six months to develop a vaccine. The government properly allocated funds to come up with a more efficient way to come up with a vaccine. 40 million that was allocated earlier this year before the recent shortage.

On the other hand, Project BioShield passed by Congress just this summer pushed by the Bush Administration allocated 5.6 billion dollars for the next ten years to develop vaccines and medications for anthrax, smallpox and other biological agents.

Once again, we -- the government does have a dilemma of how to deal with bioterrorism, how to deal with missiles and how this drains from other health and environmental priorities is just a highlight. Just looking at the flu vaccine versus Project BioShield, once again, 5.6 billion dollars. This is to develop another smallpox vaccine after the smallpox vaccines that were shipped out by CDC, many have been destroyed because they weren't used.

In this context, we as citizens are going to react to other programs that are -- that we're asked to look at, quote, asked to look at.

Now, in the 1960's, physicians were asked to prepare

a response to the possibility that there would need to be a medical response if there were a nuclear war. That was something that PSR really got energized about and led to the origins of Physicians for Social Responsibility. Studies were published based upon data gathered from Hiroshima and Nagasaki. And it was concluded that nuclear war could very well bring on the final epidemic.

So how do you prepare for nuclear war? What would be the environmental impact of such an event? I believe that the BMDS escalates the arms race and will not make us any safer. We need to utilize non-weapon system approaches to try to accomplish the goal, if our goal is really making our world safer.

Thank you.

MR. BONNER: Are there other folks who would like to speak? If you'd like to sit there, that is fine. You can stay there. Just give us your name.

CHARLOTTE DEFTEREOS: I'm Charlotte Deftereos and I agree with everything my husband, Pallo Deftereos, said.

Now that I have a chance to speak, it's going to be, I promise you, real short. This lady here suggested something that I've been thinking a long time and that was the use of the Marshall Plan.

Can you imagine what the chain reaction to the Marshall Plan by a number of countries would be?

That is all I think I've got to say.

MR. BONNER: Thank you.

SHAUNA SMITH: Hi. I'm Shauna Smith. I'm with the Physicians for Social Responsibility and Therapists for Social Responsibility. I want to know if it's possible to get a tape of the comments that have been spoken today?

MR. BONNER: I don't know that we'll have a tape but we'll have a tape of the comments. I believe it will be available -- I believe if you can put a checkmark next to your name or send us an email, we'll get that to you.

Thank you.

UNIDENTIFIED SPEAKER: I have already spoken but I wanted to ask a question. I'll try to be brief. I wanted to address a question to you, sir, and your associates.

Will you pledge to advocate for increasing the number of hearings and public, you know, opportunities for public input on this environmental impact report?

MR. BONNER: Marty, you want to speak to that?

MR. DUKE: I mean, we've looked at --

UNIDENTIFIED SPEAKER: Who is "we"?

MR. DUKE: I say myself. We are trying to publicize this. We have the website and try to make comments because it's really impossible to go to all of the sites we need to go to. And we try to give the avenues for people to have an opportunity through the website, through

public forums, through email, faxes to make their case known to the Programmatic EIS.

CAROLINE SCHMIDT: Why Sacramento? Why was Sacramento picked?

KAREN BLOMQUIST: You missed 3,000 miles of country between Arlington and Sacramento.

MR. DUKE: We looked at the states where we have a lot of the MDS program and the Capitol.

KAREN BLOMQUIST: That is not good enough. You'll be hearing from Europe because of it not just of the U.S. It will never be good enough. No matter how you sugarcoat it, it ain't good enough.

MR. BONNER: Any other comments?

ROD MACDONALD: You know, I -- I really find it just stunning that something this national importance -- I heard about it because somebody called in on a local radio show and started talking about it and I -- what? What am I hearing in the midst of traffic? I put it on my calendar. I don't really have time as a scientist to study all of this. I find it just stunning that this much impact or -- you know, your adequate four times we've done it. But what publicity? The Bee isn't here. We know how to turn people out for Staples Stadium. We can sell the world. We can't -- I find it stunning by the lack -- how it's under-publicized.

Now we've done it. We have gone through the formality. Give us an email and website. That is nice. But the organic standards, where they try to ruin organic standards, sewage waste and stuff like that. The government got more feedback than it has ever gotten on a single issue before.

PALLO DEFTEREOS: This is such a tremendous issue. I just don't -- I've been studying it, as I said, for 60 years. I was in World War II. And I studied foreign affairs before the war started. And with an issue of this size, what is the big hurry? I mean, these kinds of hearings should be had -- should be had all over the country. I just don't understand it.

MR. BONNER: Thank you.

SHAUNA SMITH: I just would like to ask, do you actually have any power to make any of these -- I don't think we should actually be harassing you guys. You don't really have the power to make the decisions, do you?

MR. DUKE: Our point is to try to assess the impact of BMDS on the environment, to provide opportunities and very spirited comments, heartfelt comments that you have provided for us on the record and try to address those.

SHAUNA SMITH: But if we wanted more meetings, you couldn't make it happen anyway, right?

MR. DUKE: We'd have to look it --

SHAUNA SMITH: But you, personally --
MR. DUKE: -- or the political impacts --
SHAUNA SMITH: You, personally, could you do anything?
MR. DUKE: I would have to go back, go with the heart of leadership.
SHAUNA SMITH: We'd appreciate it if there was any chance.
MR. DUKE: Again, I appreciate you all coming out. Like you said, a lot of you came out after a hard day's work to provide the comments. And we all know these are very sincere comments. We'll take the comments and go back and look at them and address them in the EIS.
I appreciate you all coming out and providing your comments.
Thank you.
(The proceedings concluded at 9:43 p.m.)

CERTIFICATE

OF

CERTIFIED SHORTHAND REPORTER

The undersigned certified shorthand reporter of the state of California does hereby certify:

That the foregoing deposition was taken before me at the time and place therein set forth, at which time the witness was duly sworn by me;

That the testimony of the witness and all objections made at the time of the deposition were recorded stenographically by me and thereafter transcribed, said transcript being a true copy of my shorthand notes thereof.

In witness whereof, I have subscribed my name this date____.

____

Certificate Number___________

Exhibit B-15. Anchorage, Alaska Public Hearing Transcripts

MISSILE DEFENSE AGENCY'S BALLISTIC

MISSILE DEFENSE SYSTEM DRAFT PROGRAMMATIC

ENVIRONMENTAL IMPACT STATEMENT

October 21, 2004

Sheraton Hotel, Kuskokwim Room
Anchorage, Alaska

RECORDED AND TRANSCRIBED BY:

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INDEX

MR. DUKE: Okay, let's go ahead and get started. I've got a little bit after 7:00 o'clock and we'll go ahead and start the formal presentations.

Tonight, I'd like to welcome you to the public hearing for the Missile Defense Agency's Ballistic Missile Defense System Draft Programmatic Environmental Impact Statement. This public hearing is being held in accordance with the National Environmental Policy Act, or NEPA. My name is Marty Duke and I am the Missile Defense Program Manager for the development of the Programmatic Environmental Impact Statement.

I would like to introduce Colonel Mark Graham, who is from the Missile Defense Agency's Office of General Counsel. Colonel Graham will talk about the Draft Programmatic Environmental Impact Statement, the NEPA process, and the BMDS capabilities and components. I also would like to introduce Mr. Peter Bonner and Ms. Deb Shaver, with ICF Consulting. Ms. Shaver was the ICF Consulting Program Manager and technical lead for the PEIS, and Mr. Bonner will facilitate tonight's meeting.

So I'd like to turn it over to Mr. Bonner who will review tonight's meeting agenda and discuss some administrative points on how to provide public comments on the Programmatic EIS

MR. BONNER: Hi. I'd also like to welcome you

to the public hearing tonight. First, let's define a couple of terms you're going to hear tonight. We'll refer to the Missile Defense Agency as the MDA, we'll review the Ballistic Missile Defense System or BMDS, and discuss the Programmatic Environmental Impact Statement or PEIS.

Therefore, at the hearing we're going to discuss the development of MDA, Draft BMDS PEIS. Everybody have all those acronyms down? We'll then discuss the proposed action, which is the implementation of an integrated BMDS. The activities involved in implementing this BMDS have been analyzed for their potential environmental impact. Finally, we will provide a forum to collect your public comments on the Draft PEIS.

To ensure MDA has sufficient time to receive oral comments this evening, we will use the following agenda that you see up on the screen. We will spend the next 30 to 40 minutes presenting information about the BMDS, the NEPA process, that's the National Environmental Policy Act, as Marty said. And the presentation will discuss the following: What is a programmatic EIS? What is the BMDS? How were potential impacts analyzed? What are the results of the analysis? And how does we submit comments on the Draft PEIS? We'll then take a 15-minute break during which if you would like to sign up at the registration table to make public comment, you can do it then. I see a number of you have already signed up to do that.

After the break, each speaker will be called in the order they signed up to come up and make their statements. Following the public statements MDA representatives will be available in the poster area to clarify the information provided during the presentation. Please note that questions or comments provided informally to MDA representatives in the poster area will not be officially recorded. However all questions can be formally submitted to MDA through one of the other available methods.

The most important aspect of tonight's meeting is the public comment portion. All public comments and statements provided tonight will be recorded for a transcript. We have a court reporter here doing that. Please remember that the Programmatic EIS is just a draft document. This is your opportunity to provide comments before it is finalized and before a decision is made. We are here to listen firsthand to your suggestions and concerns. Please limit your comments to five minutes to give everyone an opportunity to speak.

The real purpose of this meeting is to gather your comments. Your comments and questions will be recorded tonight and will be carefully considered in the preparation of the Final PEIS. If you wish to provide written comments as an alternative, forms are available at the registration table to do that. You may leave written comments at the registration table with us or you may mail, e-mail or fax those to the MDA

using the information provided. To allow time to consider them and respond to comments in the Final PEIS, all comments must be received no later than November 17, 2004.

Colonel Graham will now discuss the BMDS PEIS and the NEPA process. Thank you.

COL. GRAHAM: Thank you, Peter. Good evening everybody.

NEPA establishes our broad national framework for protecting the environment. NEPA requires Federal agencies to consider environmental impacts of proposed actions and reasonable alternatives to those actions early in their decision-making process. The NEPA process is intended to help public officials make decisions based on understanding environmental consequences and take actions that protect, restore, and enhance the environment.

In the past, the national approach to missile defense focused on the development of individual missile defense elements or programs, such as the Patriot, the Airborne Laser, and ground-based interceptors. These actions were appropriately addressed in separate NEPA analysis that MDA, its predecessor agencies, and executing agents prepared for these systems.

The aim of missile defense has been refocused by the Secretary of Defense to develop an integrated Ballistic Missile Defense System that would be a layered system of

components working together capable of defending against all classes and ranges of threat ballistic missiles in all phases of flight. Because the integrated Ballistic Missile Defense System is a large program made up of many projects implemented over time on a worldwide basis, MDA has determined that a programmatic NEPA analysis would be appropriate. Therefore, the MDA has prepared a Programmatic EIS to analyze the environmental impacts of implementing the proposed program.

A Programmatic EIS, or PEIS, analyzes the broad environmental consequences in a wide-ranging Federal program like the Ballistic Missile Defense System. A PEIS looks ahead at the overall issues in a proposed program and considers related actions together in order to review the program comprehensively. A PEIS is appropriate for projects that are broad in scope, are implemented in phases and are widely dispersed geographically. A PEIS thus creates a comprehensive, global analytical framework that supports subsequent analysis of specific activities at specific locations.

The Programmatic EIS is intended to serve as a tiering document for subsequent specific Ballistic Missile Defense System analyses and includes a roadmap for considering impacts and resource areas in developing future documents. This roadmap identifies how a specific resource area can be analyzed and also includes thresholds for considering the significance of environmental impacts to specific resource

areas. This means that ranges, installations, and facilities at which specific program activities may occur in the future could tier their documents from the PEIS and have some reference point from which to start their site-specific analyses.

The Ballistic Missile Defense System Programmatic EIS analyzes the potential environmental impacts of developing, testing, deploying, and planning for decommissioning for the proposed program. The Programmatic EIS evaluates proposed Ballistic Missile Defense System technology, components, assets, and programs and considers future development and application of new technologies.

The proposed action considered in the BMDS Programmatic EIS is for the MDA to develop, test, deploy, and to plan for decommissioning activities for an integrated Ballistic Missile Defense System using existing infrastructure and capabilities, when feasible, as well as emerging and new technologies to meet current and evolving threats.
When feasible, the MDA would use existing infrastructure to implement the BMDS and would incorporate new technologies and capabilities as they become available. This would ensure that the program could provide defense both for current and future ballistic missile threats.

The purpose of the proposed action is to incrementally develop and deploy a Ballistic Missile Defense

System, the performance of which can be improved over time, and that layers defenses to intercept ballistic missiles of all ranges in all phases of flight. The proposed action is needed to protect the United States, its deployed forces, friends, and allies from ballistic missile threats.

In this Programmatic EIS, MDA considers two alternative approaches to implementing the Ballistic Missile Defense System in addition, of course, to the No Action Alternative. The alternative approach is the use of weapons from land-, sea-, air-, and space-based platforms.

Alternative 1 is to develop, test, deploy, and plan to decommission an integrated Ballistic Missile Defense System that includes land-, sea-, and air-based weapons platforms. The BMDS envisioned in Alternative 1 would include space-based sensors, but would not include space-based defensive weapons.

Alternative 2 is to develop, test, deploy, and plan to decommission an integrated Ballistic Missile Defense System that includes land-, sea-, air-, and space-based weapons platforms. Alternative 2 would be identical to Alternative 1, with the addition of space-based defensive weapons.

The Council on Environmental Quality requires -- the regulations require that when in implementing NEPA, you also require the consideration of the No Action Alternative. Under the No Action Alternative, the MDA would not develop,

test, deploy or plan for decommissioning activities for an integrated Ballistic Missile Defense System. Please note that under the No Action Alternative, MDA would continue existing development and testing of individual elements as stand-alone defensive capabilities. Individual systems would continue to be tested but would not be subjected to system integration tests.

Alternatives 1 and 2 provide different weapons platforms options for implementing an integrated Ballistic Missile Defense System while the No Action Alternative continues the traditional approach of developing individual missile defense elements, such as Airborne Laser, Patriot missiles or ground-based interceptors.

I will now address how MDA characterizes the Ballistic Missile Defense System into relevant components and lifecycle activities that could be considered to provide a programmatic review of the environmental impacts of implementing the proposed action.

MDA’s goal is to develop an integrated Ballistic Missile Defense System that will provide a layered defense. The Ballistic Missile Defense System would be capable of destroying threat ballistic missiles in the boost, midcourse and terminal flight phases and would defend against short, medium, intermediate, and long-range threat ballistic missiles. Finally, the Ballistic Missile Defense System would integrate

sensors and weapons through a command control, battle management, and communications network, or C2BMC. With this capability the integrated Ballistic Missile Defense System would establish a defense against threat ballistic missiles.

The Ballistic Missile Defense System is a complex system of systems. To be able to perform a meaningful impact analysis, we considered the Ballistic Missile Defense System in terms of its components: weapons, sensors, C2BMC, and support assets. These components are the building blocks that can be assembled with specific functional capabilities and operated together or independently to defeat threat ballistic missiles. Testing was considered for each component; however, the integrated missile system that we would propose needs to be tested at the system level and was analyzed separately using realistic system integration flight test scenarios. Now, let's look at each of these components.

First component is weapons. Weapons would provide defense against threat ballistic missiles. They include interceptors, directed energy weapons in the form of high-energy lasers that would be used to negate threat missiles. Interceptors would use hit-to-kill technology, either through direct impact or directed fragmentation. Ballistic Missile Defense System weapons are designed to intercept threat ballistic missiles in one or more phases of flight and could be activated from land, sea-, air-, or space-

based platforms.

Ballistic Missile Defense System sensors would provide the relevant tracking data for threat ballistic missiles. Sensors detect and track threat missiles and assess whether a threat missile has been destroyed. Sensors provide the information needed to locate and track a threat missile to support coordinated and effective decision-making against the threat.

There are four basic categories of sensors considered for the Ballistic Missile Defense System. They are radar, infrared, optical, and laser sensors. Radars send a signal out and detect the same signal as it bounces off an object. Infrared sensors are passive sensors that detect and track heat or infrared radiation from an object. Optical sensors are also passive sensors but they collect light energy or radiation emitted from an object. Laser sensors use laser energy to illuminate and detect an object's motion. Lasers and radars emit radiation while infrared and optical sensors detect radiation that has been emitted. Ballistic Missile Defense System sensors would operate from multiple platforms, such as land, sea, air, or space.

The data collected by the sensors would travel through the communication system to command and control centers where a battle management decision on whether to use a defensive weapon would be made. C2BMC would integrate and

coordinate equipment and operators through command and control and integrated fire control centers. C2BMC would enable military commanders to receive and process information, make decisions and communicate those decisions regarding the engagement of threat missiles. The C2BMC would include fiber optic cable, computer terminals, and antennas and would operate from land-, sea-, air-, and space-based platforms.

The last category of support assets. Or, excuse me, the last category of components is support assets. Support assets would be used to facilitate development, testing and deployment of Ballistic Missile Defense System components. Support assets are one of three types: support equipment, infrastructure or test assets. Support equipment includes general transportation and portable equipment such as automobiles, ships, aircraft, rail and generators. Infrastructure includes using docks, shipyards, launch facilities and airports. Test assets include test range facilities, targets, countermeasure devices, stimulants and observation vehicles.

Now that we have discussed the components, Mr. Marty Duke will describe how they can be integrated into the Ballistic Missile Defense System.

MR. DUKE: This slide depicts the integration of the various components of the proposed BMDS that Colonel Graham just discussed. The use of multiple defensive weapons

and sensors operating from a variety of platforms integrated through a single C2BMC system would create a layered defense allowing several opportunities to intercept and destroy the threat missile. For example, one weapon could engage a threat missile in its boost phase, represented here in the red, and another could be used to intercept the threat missile in later phases if initial intercept was unsuccessful in the boost phase. So we could intercept in the midcourse or in the terminal phase.

Components are incorporated into the BMDS through the lifecycle phases of the system acquisition process. These lifecycle phases are development, testing, deployment, and decommissioning. New components would undergo initial development testing, while existing components would be tested to determine their readiness for use. Work on a given technology would stop if testing failed to demonstrate effectiveness or if functional capability requirement changed. Components and elements would be deployed as testing demonstrates that they have capabilities of defending against threat ballistic missiles.

In most cases, a component would be deployed when testing demonstrates that it is capable of operating within the integrated BMDS and the associated safety and health procedures are developed and adequate. This process concludes with decommissioning, which would occur when and where

appropriate.

To determine environmental impacts, this PEIS analyzed the proposed BMDS components by considering the various lifecycle phase activities of each component, as well as the operating environments in which the activities are taking place. This slide tries to depict the multi-dimensional complexities involved in considering the impacts of implementing an integrated BMDS. In terms of its components, as we have here, the weapon, sensors, C2BMC, supports, against their lifecycle activation activities, against their operating environment.

Because of the complex nature of this project, an analysis strategy was developed to effectively, yet efficiently, consider the broad range of environmental impacts from the proposed BMDS. First, the existing condition of the affected environment was characterized for the locations where various BMDS activities are proposed to occur.

Next, MDA determined the resource areas that could potentially be affected by implementing the proposed BMDS.

Finally, impacts of the BMDS were analyzed in four steps. In Step 1, we identified and characterized life cycle phase activities. In Step 2, we identified activities with no potential for impact and dismissed them from further analysis. In Step 3, we identified similar activities across

lifecycle phases and combined them for analysis. And in Step 4, we conducted the impacts analysis for all remaining activities. The first three steps were used to characterize and reduce the number of unique lifecycle activities, thereby reducing the redundancy in preparing the impact analysis.

The affected environment includes all land, air, water, and space environments where proposed BMDS activities are reasonably foreseeable. The affected environment has been considered in terms of the broad ocean area, the atmosphere, and nine terrestrial biomes. A biome is a geographic area with similar environments or ecologies. Climate, geography, geology and distribution of vegetation and wildlife determine the distribution of the biomes. These biomes encompass both U.S. and non-U.S. locations where the BMDS could be located or operated.

The resource areas considered in this analysis are those resources that can potentially be affected by implementing the proposed BMDS. NEPA analyses generally consider the resource areas listed on the screen, except for orbital debris. Because missile defense development and test activities include the launch and intercept of missiles, space-based communications and other satellites, and potential for space-based interceptors, MDA also considered orbital debris and its impacts on the Earth.

This PEIS discusses all resource areas,

provides a methodology for analysis and suggests a thresholds of significance to provide the reader with a roadmap for performing future site-specific analysis tiering from the PEIS. These discussions outline the type of information that would be needed to conduct site-specific analyses and identify the steps necessary to ensure that potential impacts are appropriately considered. The resource areas, highlighted on the slide with a red star, require site-specific information for analyses and are those more effectively addressed in subsequent tiered analyses for specific activities.

Once we decided how to consider the affected environment and the resource areas of concern, we used the four-step process I mentioned earlier. In Step 1 of the impacts analysis, MDA identified and characterized the activities associated with each BMDS component. Each lifecycle phase has activities applied to each component.

For example, development can include planning, research, systems engineering, and site preparation and construction. Testing can include manufacturing, site preparation and construction, transportation, activation, and launch activities. Deployment can include manufacturing, site preparation and construction, transportation, activation, launch, operation and maintenance, upgrades, and training. And finally, decommissioning includes demilitarization and disposal.

Once lifecycle activities were identified, it was determined that some of those activities had no potential for impact. Activities such as planning and budgeting, systems engineering and tabletop exercises are generally categorically excluded in various Department of Defense NEPA regulations and, therefore, not further analyzed in this PEIS. Other activities for specific components, such as transportation, maintenance and sustainment, and manufacturing, were not analyzed in this PEIS because they have been evaluated in previous NEPA analyses or found to have no significant environmental impacts.

The remaining activities were then examined to determine which activities had similar environmental impacts. For example, impacts associated with site preparation and construction in the development phase would be similar to or the same as impacts from site preparation and construction activities in the deployment phase. Under Step 3, similar activities occurring in different lifecycle phases were identified and considered together to reduce redundancy.

The final step was to determine the impact associated with each remaining activity under the proposed action. The significance of an impact is a function of the nature of the receiving environment and the receptors in that environment.

For example, an interceptor launch creates the same emissions no matter where it is launched. Whether those

emissions cause impacts and the significance of those impacts depend upon the environment into which they are released. The PEIS analyzes these emissions by component for each resource area and lifecycle activity where a potential for impact was identified. Impacts were distinguished based on the different operating environments, land, sea, air, and space. The analysis also considered specific impacts for individual biomes where activities could occur.

The impacts of system integration tests were considered separately from the impacts of individual component testing because integration testing would involve using multiple components in the same tests. To deal effectively with integration testing MDA looked at two generic systems integration flight test scenarios which involved different numbers of launches and intercepts.

The impacts analysis for Alternative 1 considers the use of land-, sea-, and air-based platforms for BMDS weapons. The analysis includes the use of space-based sensors, but not space-based weapons. The analysis is specific for each resource area based on the impacts from the activities associated with the BMDS component.

The impacts analysis for Alternative 2 includes the use of interceptors from land-, sea-, air- and space-based platforms for BMDS weapons. The impacts associated with the use of interceptors from land, sea, and air platforms would be

the same as those discussed for Alternative 1; therefore, the analysis for Alternative 2 focuses on the impacts of using interceptors from space-based platforms. Therefore, the fundamental difference between Alternative 1 and 2 is that Alternative 2 includes the analysis of space-based platforms for interceptors.

The cumulative impacts of implementing the BMDS were also considered. Cumulative impacts are defined as impacts that result from the incremental impacts of the proposed action when added to other past, present, and reasonably foreseeable future actions. Because this proposed action is worldwide in scope and potential application, only activities similar in scope have been considered for cumulative impacts.

Under Alterative 1, worldwide launch programs for commercial and government programs were determined to be activities of similar scopes. Therefore, the impacts of BMDS launches were considered cumulatively with the impacts from other worldwide government and commercial launches.

Alternative 2 includes placing defensive interceptors in space, which involves adding additional structures to space for extended periods of time. The International Space Station was determined to be an action that is international in scope and has a purpose of placing structures in space for extended periods of time. Therefore,

the impacts of the use of space-based weapons platforms were considered cumulatively with the impacts of the International Space Station.

The next few slides provide broad summaries of the impacts analysis by BMDS component and Test Integration for Alternatives 1 and 2, the No Action Alternative, and the cumulative impacts for Alternatives 1 and 2. Please note that the results are extremely high level suitable for this presentation. Additional details have been provided in some of the posters that you've seen in the hallway in the back. The impacts analysis may also be found in the Executive Summary Impact tables and in Section 4 of the Draft PEIS.

It is important to note that no environmental showstoppers were found in this programmatic impact analysis. As the next few slides show there are potential impacts associated with the various activities needed to implement the BMDS. However they would be appropriately addressed in subsequent tiered NEPA analyses along with the mitigation actions as required to ensure less than significant impacts.

This slide shows a summary of the broad potential for environmental impacts associated with BMDS weapons activities as examined for each resource area for Alternatives 1 and 2. Please note that this is a very high-level depiction of the results of the analysis and additional details of the weapons analysis may be found in the Executive

Summary of the Draft PEIS. However, one can see from these slides general activities and resource areas that should be considered in subsequent tiered NEPA analyses.

This slide shows the impacts summary for BMDS sensors. Note that the impacts are the same for Alternatives 1 and 2 and include space-based sensor platforms. This summary also shows how MDA’s categorization of activities helped to simplify the analysis. For example, the activities of radar would not impact air quality because the only emissions resulting from radars would be from supporting diesel generators, which are addressed under support assets. However, radars generate electromagnetic radiation, which could potentially impact biological resources.

Although C2BMC is the glue that enables the integrated BMDS to function effectively as a system, this component creates little potential for environmental impacts.

Impacts associated with support assets are mainly those that would be caused by site preparation and construction of infrastructure and by using test assets such as countermeasures and stimulants during testing.

Test integration, overall, has the most potential for impacts because it includes the use of several components during increasingly realistic test scenarios. Although this programmatic analysis showed the potential for impacts, the existing environment at the proposed test location

and the specific test activities planned will determine the nature and extent of the impacts.

The No Action Alternative would continue the development and testing of individual weapons, sensors, C2BMC, and support assets and would not include integration testing of these components. The environmental impacts of the No Action Alternative would be the same as the impacts resulting from continued development and testing of individual missile defense elements.

The decision not to deploy a fully integrated BMDS could result in the inability to respond to a ballistic missile attack on the U.S. or its deployed forces, allies, or friends in a timely and successful manner. Further, this alternative would not meet the purpose or need of the proposed action or the specified direction of the President and the United States Congress.

We examined the impact of worldwide launches for cumulative impacts. Launches can create cumulative impacts by contributing to global warming and ozone depletion. Potential launch emissions that could affect global warming include carbon monoxide and carbon dioxide, or CO2. Unlike CO2, carbon monoxide is not a greenhouse gas, but it can contribute indirectly to the greenhouse gas effects. The cumulative impact on global warming of emissions from BMDS launches would be insignificant compared to emissions from other industrial

sources, such as energy generation. The BMDS launch emissions load of CO_2 and carbon monoxide would only be five percent of the emissions load from worldwide launches. In addition, CO_2 and carbon monoxide from 10 years of BMDS and worldwide launches combined would account for much less than one percent of CO_2 and carbon monoxide emissions from U.S. industrial sources in a single year.

Chlorine is of primary concern with respect to ozone depletion. Launches are one of the man-made sources of chlorine in the stratosphere. The cumulative impacts on stratospheric ozone depletion from launches would be far below the effects caused by other natural and man-made sources. The emission loads of chlorine from both BMDS and other launches worldwide occurring between 2004 and 2014 would account for about half of one percent of the industrial chlorine load from the U.S. in a single year.

The orbital debris produced by BMDS activities would generally be small in size and would consist primarily of launch vehicle hardware, old satellites, bolts and paint chips. It may also be possible for debris from an intercept to become orbital debris. However, orbital debris produced by BMDS activities would occur in low-earth orbit where debris would gradually drop into successively lower orbits and eventually reenter the atmosphere. Therefore, orbital debris from BMDS activities would not pose a long-term hazard to the

International Space Station or other orbiting structures. In addition, collision avoidance measures would further reduce the potential for orbital debris to damage orbiting structures, such as the International Space Station.

I would like to reiterate that our impacts analysis indicated no expected areas of significant impacts on the environment. However, many resource areas showed potential for impacts indicating that these areas need to be considered in any subsequent analyses tiered from this PEIS.

Okay, this is the conclusion of the summary of our findings. Now, I'd like to turn to Peter Bonner who will discuss some of the administrative comments -- points on making the public comments.

Peter.

MR. BONNER: Thank you, Marty. Now that we've reviewed the proposed BMDS and the potential impacts from its implementation, let's discuss the PEIS schedule. The PEIS development process started with the Notice of Intent, or NOI, which was published in the Federal Register on April 11th, 2003. MDA released the Draft PEIS in September. The public comment period for the Draft PEIS, currently underway, will continue through November 17th, 2004. After that time, the MDA will consider all comments received and incorporate appropriate changes in the Final PEIS. A release date for the Final PEIS is estimated for December 2004 or January 2005. After the

release of the Final PEIS there will be a 30-day waiting period before the MDA can issue the Record of Decision, or ROD, one more acronym.

There are a number of ways in which you can provide comments on the Draft BMDS PEIS. You may provide your comments orally or in writing. Oral and written comments will be given equal consideration in preparing the PEIS -- the Final PEIS.

If you would like to make a public statement at Tonight’s meeting, we encourage you to sign up at the registration table and fill out a speaker’s card. Each speaker will be given five minutes to make a statement. The five minutes are your time. If you need significantly more time than the five minutes, I'd ask that you yield to another speaker and then come back at the end after the final speaker has finished to continue your input.

As mentioned earlier, public statements by Tonight’s speakers will be recorded by the court reporter to ensure that we accurately capture your comments on the Draft PEIS. There is also a toll-free telephone number on which you might submit comments. Please refer to your handouts for the toll-free phone number. Another option is to submit your comments in writing. There are four ways to do this. First, you may leave written comments that you brought with you tonight with the person at the registration table. Second, you

can use the comment forms that are available at the registration table to write down your comments. You may either turn those in tonight or you may fax or mail them to MDA using the addresses and toll-free tax number -- toll-free fax number, not tax number, that appear on the comment forms. You may also e-mail your comments to MDA using the addresses listed in the handouts and on the MDA BMDS PEIS web site.

Finally, you may submit comments through the PEIS web site using an electronic comment form. To ensure that your comments are adequately considered in the Final BMDS PEIS, they must be received no later than November 17th.

The information on the screen lists the various ways you could submit your comments. This information is also listed on the comment forms at the registration table and handouts available near the posters.

Please visit the BMDS PEIS web site for additional information. The web site provides descriptions of topic areas that we touched on this evening, as well as links for obtaining additional information. The materials handed out tonight are also posted on the BMDS PEIS web site.

We encourage you to sign up to receive a hardcopy of the Executive Summary of the Final PEIS and a CD-ROM containing the entire document when it becomes available. To do this, please fill out the appropriate form at the registration table. You can also request a copy of the

Executive Summary or CD-ROM of the entire document by sending an e-mail to us, to the address listed in the handout materials and on the screen. The Final PEIS will also be available in .pdf format to download from the BMDS PEIS web site and hardcopies will be placed in local libraries. A list of these libraries is available on the BMDS PEIS web site.

If you haven't signed up to receive these materials, please do so during the break out in the registration area.

Marty.

MR. DUKE: Okay. Our purpose of being here tonight is really to listen to you, to hear your comments on our Draft PEIS. No decisions will be made on the PEIS tonight. We'll take your comments, all the comments we have received during the comment period of oral, written, faxed and consider those in the Final PEIS. But, again, as Peter mentioned we need all comments in by November 17th.

So let's go ahead and take about a 10- or 15-minute break and then we'll come back. It allows us to set up for the public statement period. After the public statement period we'll be available to answer additional questions you may have out at the poster area, okay?

Thank you.

(Off record)

(On record)

MR. BONNER: Let's get started again. I have the list of registered speakers and I'll call each person to the front of the room to the microphones provided to make their comment. Please limit your remarks to five minutes. As we said, if you have additional comments to make after the five minutes, if you could wait until the last speaker speaks and then we'll bring you back up again.

To help you keep track of the time, after about four minutes I will hold up my very expensive and fancy sign here that says you've got a minute left. This should help you find a comfortable place to wrap up your comments. If you have a written version of your comments, we ask you provide it to us to facilitate keeping an accurate record of them. When providing your public statement, please remember to state your name and, if you have an affiliation, give us that too. And if you speak clearly for the meeting recorder that would be helpful.

Okay. If you do not wish to give an oral statement here tonight, please consider providing comments to using one of the available methods we talked about earlier. We tried to develop a lot of avenues for you to give us your comments. Thanks again for your participation in this process.

Have Jean Bodeau come up.

MS. BODEAU: Hello, my name is Jean Bodeau and I have no affiliation with an organization. I'm a professional

geologist and engineer and I've worked as an environment consultant in Alaska for almost 20 years. I now work in health care. Some of the work I've done as a consultant is I've managed several million dollars worth of military contracts, mostly for the Air Force.

I oppose the entire program on both philosophical and concrete grounds, with specific points as follows:

First, it doesn't address the real threat, i.e., terrorist with low tech devices that could come over borders, by sea, suicide bombers. I understand the Iraqi insurgents now are trying to get more weapons of mass destruction. This project, to me, seems totally divorced from the realities that we're facing as a country and takes funds away from the real threats.

Two, the sequencing on the whole program seems backward. The EIS is late and the project is premature. Furthermore, the technology doesn't appear to work, yet it is already being deployed.

Three, NEPA does not seem, to me, to be a big enough vehicle to evaluate the program. It should include international input because the implications of this project are global. And I noticed on your map out there Antarctica is not included on the map. I'm sure you looked at it but.....

Fourth, the PEIS, with all due respect, I know

a lot of work went into it, is -- in my opinion it's crap. I've worked on these things quite a bit and I know that you can manipulate your data, manipulate your analyses to come out with exactly the results you desire. And I think that's what's been done here. It ignores or glosses over potential concerns and it put many other assessments off to future assessment to the site-specific assessments, the tiered impact -- or the tiered assessments that you mentioned.

I noticed on the summary and in the documents, I've looked through those. I got them in the mail and I appreciate those being sent out in advance. There are a huge number no significant impacts listed. And I think that this issue is a big enough and hugely important issue that it deserves more than a cursory analysis of the environment impacts.

I have some more specific concerns, things that the PEIS does not adequately address. Number one, exposure to increased levels of toxic pollutants from a dramatic increase in missile launches. Liquid propellants containing hydrazine, nitrogen tetroxides and other compounds that are highly toxic. In addition, ammonium perchlorate, which is used in solid propellants, it blocks the formation of key thyroid elements that are critical for growth and development, especially in fetuses and children, and this was not considered.

Another concern is that the risk to health and

safety of DMD missile accidentally shooting down civilian and friendly military aircraft was not considered.

Third, it neglected to look at space debris from high altitude midcourse missile intercepts or destruction of satellites, and it really glossed over potential impacts of debris falling to earth. It just wrote them off as being burned up in the atmosphere.

Another concern is that it didn't really look at the many rocket launches that are needed to test and deploy and maintain the space interceptors.

Five of the specific points, the program could contribute to the proliferation to the weapons of mass destruction and an arms race in space. The response of other nations to the BMDS has not been considered.

Six, radioactive fallout from intercepted missiles has not been considered. The effects of war are normally excluded from analysis by NEPA; however, this proposed BMDS action is very likely to provoke a worldwide WMD arms race and force other nations to prepare to launch a massive retaliation against the U.S. should war ensue. And I believe that radioactive fallout needs to be looked at and not written off as a no significant impact.

Seven, also missing is an assessment of impacts to the environment, human health and welfare and future generations, which would result from the monstrous financial

burden of this program and taking resources away from other critical aspects of our nation.

And, last, the BMDS PEIS does not really include a No Action Alternative. Your No Action Alternative does not include the option of not deploying any of these, there's just dropping the program right now. And I think that we need to have a true No Action Alternative considered as part of this.

I am going to submit additional written comments. Thank you for the opportunity.

MR. BONNER: Thank you. Have Steve Cleary come up.

MR. CLEARY: Hi. Thanks for having me. My name is Steve Cleary, I'm the Executive Director for the Alaska Public Interest Research Group, my acronym is AKPIRG. That's another acronym for everybody tonight.

I, like Jean, am in favor of the No Action Alternative, but would also like a real No Action Alternative, which would save us tens to hundreds of billions of dollars if we didn't deploy the system.

I remember from last time, part of about the radar, somebody from Valdez was worried about that it was going to set off airbags in cars, set off fire extinguishers, some kind of weird effects of the radar, but I didn't see any mention of that in there and I didn't get a chance to read the

whole thing. I just read the executive summary. So I would like to hear more about that.

But I think a lot of us are concerned about the integration of all these systems when all the systems aren't here. We hear about the sea-based radar that's going to be swung around and come on up and be sitting outside by Shemya, but we have five missiles in the ground, maybe six by now, and we're going to start deploying that by September, but yet this isn't due until -- you know, the Record of Decision isn't going to be until February, so the integration of the system doesn't seem to have happened, yet it all seems to be going forward and this Programmatic EIS doesn't seem to have a whole lot of effect on that.

So, again, I am here tonight to speak in favor of the No Action Alternative. I do also believe that deployment of the missile defense would spur a global arms race and cause nations to devote resources, simply because we are, to this weaponization of space.

I'm also concerned that we'll be exporting it to non-U.S.A. locations, Canada, United Kingdom and other places who might see us as a world superpower and want to, you know, receive our favors and so they would acquiesce to this system.

Specific to Alaska, I have a lot of questions about the Kodiak Launch Complex. I'm really concerned about

the aborted launch that happened at Kodiak, I believe it was two years ago November and Kodiak itself is a significant enough population center to be concerned about it, but if we start launching missiles from Fort Greeley, which is near Fairbanks, near Delta Junction, that have to be aborted, there's significant population centers there, not to mention the TransAlaska Pipeline.

Something that was mentioned in the presentation and in the PEIS, it talks about a robust testing program. It mentioned in the PEIS that the test are going to dictate which further things happen. We haven't seen a realistic test yet and that concerns us here in Alaska, particularly when, you know, like I said, an aborted launch could have such a disaster effect on our state.

It's unclear from the PEIS, and I'm looking at Section 2.242, whether or not the Kodiak Launch Complex is going to be a launch test and defensive operational asset or if it's going to launch things into orbit, or if it's just a test center. So it's confusing for the folks on Kodiak and for us here in Alaska what is actually going to happen out on the island.

It talks about a safety zone that would be established around the laser during activation. This is also in the PEIS, Pages 250 to 254. There's a lot of small plane traffic and a lot of small boat traffic around Kodiak and other

places in Alaska. It has us concerned about the laser and its effects on our economy and on the human resources, or humans, I should say, of Alaska.

The hydrazines that Jean mentioned were the same things that I believe came from when the space shuttle crashed and landed in Texas and there was a very large mobilization to get people not to touch those things. And if that's the same chemical that's going up with each of these launches and potentially coming back down, then those will be grave consequences indeed.

A lot of the missile defense system has been sold up here in Alaska for the economic benefits. And I know the Programmatic EIS also takes in social and economic benefits and I could think of a lot better ways for us to spend these hundreds of billions of dollars that will eventually be spent on this system that isn't going to work and is also addressing the least likely threat.

So I thank you for the opportunity to speak in favor of the No Action Alternative. Thanks.

MR. BONNER: Thank you. Can I have Greg Garcia come up? Greg.

MR. GARCIA: Yes, hello. My name is Greg Garcia, I'm a member of Alaskans for Peace and Justice, as well as No Nukes North. There's just a few brief things I'd like to say about this. I mostly want to comment on it as a policy

issue. I realize that, you know, the purpose of this is to take testimony about the actual environmental impact of this and I'm not really all that knowledgeable. I've looked at a lot of the materials about it, about the environmental aspects and, frankly, you know, I'm not probably qualified to interpret a lot of the things that are said there.

However, I do definitely oppose the space-based weapons platform that are mentioned in Alternative 2. Certainly, you know, be opposed to putting weapons in space. I'd like to see something quite a bit less than the No Action Alternative, I'd really like to see something rolled back in a way and dismantling and using these resources, the financial resources that were wasted on this on much more pressing needs in this country.

As many people have mentioned, it does protect us from what's the least likely attack scenario. There's way too many other things going on that are threats where the resources that are being expended here could be used. For example, roughly four percent of the cargo containers coming into the United States from foreign countries are inspected in any way, and that's mostly just inspecting the paperwork, not even actually doing an actual physical inspection. And we could certainly create a lot of jobs that way, as well as by building this system. So it doesn't seem like a very good cost benefit there.

I feel that this system makes us less safe. In one way by leading to an increased arms race as we have pulled out of the 1972 ABM treaty. I think that was a mistake. By pulling out of that treaty I think we've stimulated China to increase its production of intercontinental ballistic missiles and possibly the spin off there is that India and Pakistan may be increasing their weapons as well in order to have a defense against China.

The idea to dominate space seems to be at the heart of this, that's fairly, clearly spelled out in United Space Command documents and this seems to be kind of a component of that. And it would seem to me that the desire to dominate space is just a new era of colonialism.

In conclusion, I feel that this entire system is based on corporate welfare, that the legislative process that takes place in Washington, D.C. seems to be dominated by huge multinational corporations that want to build the system and so they have managed to lobby and provide the funding for the campaigns for the Congress people, Senators and Representatives who have approved for this program to take place, so that they get to become even more fabulously wealthy than they are now by building a system that, frankly, doesn't work.

Thank you.

MR. BONNER: Thank you. Have Christine

Reichman come up.

MS. REICHMAN: Hello, I'm Christine Reichman. Just here on my own. I'm an amateur church musician and a mother. I'd like to go on record opposing the construction of these new weapons. I prefer the No Action Alternative, bad as it is, given only three choices. I oppose the new weapons system being discussed because it is destabilizing ecologically with space debris radioactive material and other pollutants. Because it's destabilizing economically using resources that we should be using for helpful things for our civilization. Because it's destabilizing politically, because it encourages aggression by us and towards us. It's not just the physical environment that is endangered, though it certainly is, it is also our cultural environment. New weapons increase distrust among people, create new enemies, reinforce old prejudices against peaceful needs. We can refuse to be each other's enemies.

Thank you.

MR. BONNER: Thank you. Have Tom Macchia come up.

MR. MACCHIA: Thanks for the opportunity to make a few comments.

I guess my first question about this is I'm really kind of concerned and troubled that we're talking about an Environmental Impact Statement for a program that's already

begun -- that's already started to deploy. I thought that standard procedure was to make decisions about environmental impact, then decide whether we were going to employ [sic]. So that was one question.

I work in heath care and used to work as a researcher, so all of you who are doing work on this have my sympathy. I understand that when you're given a job you try to do the best you can with it, and you try to get some sort of an answer. In a lot of cases to make your bosses happy. And given that we have an administration that 5,000 scientists have accused of elevating junk science, and totally ignoring real science, and given that the Union of Concerned Scientists have said that this whole idea is rather preposterous and will never work. I'm also a member of -- I work in health care, I'm a member of physicians for social responsibility and they done some very excellent critiques of both the environmental impacts of this and of the whole idea. And so rather than try and duplicate their science, which I am not qualified to do, I'll just say they speak very well for me as well as far as science goes.

If this were free, at best it would be foolish. Given the fact that it's costing us so many valuable dollars, and continues to grow exponentially in terms of its budget, it's a dangerous farce, and I certainly support the No Action option.

MR. BONNER: Thank you for your comments. Have Myrna Hammond come up.

(No response)

MR. BONNER: Is Myrna here? She had to leave? Okay.

Would anyone else like to come up and speak and provide input or feedback?

MR. SOLLENBERGER: I'll come up.

MR. BONNER: Okay.

MR. SOLLENBERGER: I wrote something that I was going to (indiscernible - away from microphone)

MR. BONNER: Could you give us your name?

MR. SOLLENBERGER: Bruce Sollenberger.

MR. BONNER: Bruce. What was the last name again?

MR. SOLLENBERGER: Sollenberger is the last.

MR. BONNER: Sollenberger, thank you.

MR. SOLLENBERGER: What I wrote is any activity can be subjected to one basic question; will it work and are there alternative activities that are better use of resources? It may be possible at the cost of 500 million to a billion dollars to develop a system that can detect some missile and intercept them. Given the complexity of the system, it will be vulnerable at a number of levels. These include jamming of the ionospheric layer used to detect missiles using multiple

warhead systems, several missiles launched at once.

Implementation will undoubtedly trigger an arms race and force neighbors, such as the former Soviet Union, to adopt countermeasures. It is my view that a far better use of resources is met by a policy of mutual disarmament combined with treaties involved with not attacking and mutual aid and respect. Ultimately the question must be asked, is a protection-based program the best we can do? Or is a program of reduction of antagonism between nations not more cost effective? A billion dollars can buy a lot of aid. North Korea, for example, is starving at present. Their reaction to such a system may be to sell their nuclear weapons to a terrorist source. I believe this is a former likely way that the U.S. may be threatened. This system does nothing to address such a treat.

My thesis is that escalation of an arms race benefits no one. Rather we must deescalate the world's weaponry. We cannot live with it any longer. Sooner or later an accident will set it off and bring it down upon us.

Thank you.

MR. BONNER: Thank you. Okay. Any other comments from those who haven't spoken or others from those who have?

(No audible responses)

MR. BONNER: Marty.

MR. DUKE: Well, I would like to again thank each and every one of you for taking your time and your effort to review the document and providing the comments for us

tonight. We have your comments, we'll go back and look at each comment that you gave and consider it. And if we need to include more information in the Final PEIS, expand the areas that you're concerned about, then we'll do that.

Again, I appreciate you coming out, we take your comments seriously and thank you for your participation.

MR. BONNER: If you have any further questions, feel free to stay.

MR. DUKE: Yeah, we're going to be outside, if you have any more questions.

(Off record)

C E R T I F I C A T E

UNITED STATES OF AMERICA)
)ss.
STATE OF ALASKA)

I, Joseph P. Kolasinski, Notary Public in and for the state of Alaska, and reporter for Computer Matrix Court Reporters, LLC, do hereby certify:

THAT the foregoing MEETING FOR DRAFT PEIS was transcribed by under my direction and reduced to print to the best of our knowledge and ability;

THAT the meeting was recorded electronically by myself on October 21, 2004;

I further certify that I am not a relative, nor employee, nor attorney, nor of counsel of any of the parties to the foregoing matter, nor in any way interested in the outcome of the matter therein named.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my seal this 28th day of October 2004.

Joseph P. Kolasinski
Notary Public in and for Alaska
My Commission Expires: 3/12/2008

Exhibit B-16. Honolulu, Hawaii Public Hearing Transcripts

MISSILE DEFENSE AGENCY

BALLISTIC MISSILE DEFENSE SYSTEM

(BMDS)

DRAFT

PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

(PEIS)

PUBLIC HEARING

taken on behalf of the Missile Defense Agency at the Best Western Hotel, 3253 North Nimitz Highway, Honolulu, Hawaii, 96819, commencing at 6:34 p.m., on Tuesday, October 26, 2004, pursuant to Public Notice.

Reported by: Julie A. Peterson, CSR #361, CRR, RMR
Registered Professional Reporter
Notary Public, State of Hawaii

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PUBLIC COMMENTS

MR. DUKE: Okay, I have a little bit after 6:30 so let's go ahead and get started with the formal presentation.

I'd like to welcome everyone this evening to the public hearing for the Missile Defense Agency's Ballistic Missile Defense System Draft Programmatic Environmental Impact Statement.

This public hearing is being held in accordance with the National Environmental Policy Act or NEPA. My name is Marty Duke and I'm the Missile Defense Agency's Program Manager for the development of the Programmatic Environmental Impact Statement.

I'd also like to introduce Colonel Mark Graham who is with the Missile Defense Agency's Office of General Counsel. Colonel Graham will talk about the Draft Programmatic Environmental Impact Statement, the NEPA process, and the BMDS capabilities and components.

Also I would like to introduce Mr. Peter Bonner and Ms. Deb Shaver in the back who are with ICF Consulting. Ms. Shaver is the ICF Consulting Program Manager and the technical lead for the PEIS, and Mr. Bonner will facilitate tonight's meeting.

Again, I'd like to welcome you. Now I'd like to turn the meeting over to Peter who will go

over tonight's meeting agenda and make some administrative points on providing public comments on the Programmatic Environmental Impact Statement.

Peter?

MR. BONNER: Thanks, Marty. Good evening. I'd also like to welcome you to tonight's hearing. First I'd like to dispense with a couple of the acronyms we're going to use tonight.

As we move through the presentation, we refer to the Missile Defense Agency as MDA.

We'll review the Ballistic Missile Defense System, or BMDS, and discuss the Programmatic Environmental Impact Statement, or PEIS.

There will be a test at the end of the evening.

Therefore, at the hearing, we'll discuss the development of MDA's Draft BMDS PEIS. We will discuss the proposed action, which is the implementation of an integrated BMDS. The activities involved in implementing the BMDS have been analyzed for their potential environmental impact.

Finally, we'll provide a forum to collect public comments on the Draft PEIS.

To ensure MDA has enough time to receive your oral comments, we'll use the following agenda you

see up on the screen. We'll spend the next thirty to forty minutes presenting information about the BMDS, the NEPA process, and our analysis.

The presentation will discuss what is a Programmatic EIS, what is the BMDS, how were potential impacts analyzed in the BMDS PEIS, what are the results of this analysis, and how does one submit comments on the Draft PEIS.

After the presentation portion, we'll then have a fifteen-minute break when any of you wishing to provide oral comments can sign up at the registration table in the back.

After the break, each speaker will be called in the order in which they signed up, and come up and make their statements.

Following the public statements, MDA representatives will be available in the poster area to clarify any information we've given during the presentation.

Please note that questions or comments provided informally to MDA in the poster area will not be officially recorded. We are officially recording tonight's session and we have a court reporter here tonight to do that.

However, all your questions can be

submitted to MDA through one of a number of available methods.

The most important part of tonight's meeting is the public comment portion. All public statements provided tonight will be recorded for a transcript.

Please remember that the Programmatic EIS is a draft document. This is your opportunity to provide comments on that draft before it's finalized and the decision is made.

We're here to listen firsthand to your suggestions and concerns. Please limit your comments to five minutes to give everyone an opportunity to speak.

Your comments and questions will be recorded tonight and be carefully considered in the final PEIS.

If you wish to provide written comments, forms are available at the registration table in the back. You may leave your written comments with us at the registration table, you can mail them to us, e-mail them to us, fax them to us using MDA information provided.

To allow time to consider and respond to comments in the final PEIS, all comments must be

received no later than November 17.

Colonel Graham will now discuss the BMDS PEIS and the NEPA process. Thank you.

COLONEL GRAHAM: Good evening everyone. NEPA establishes our broad national framework for protecting the environment. NEPA requires federal agencies to consider the environmental impacts of their proposed actions and reasonable alternatives to those actions early in the decision-making process.

The NEPA process is intended to help public officials make decisions based on understanding environmental consequences, and take actions that protect, restore, and enhance the environment.

In the past, the national approach to missile defense focused on the development of individual missile defense programs or elements, such as the Patriot, the Airborne Laser, and ground-based interceptors. These actions were appropriately addressed in separate NEPA analyses that MDA, its predecessor agencies, and executing agents prepared for these systems.

The aim of missile defense has been refocused by the Secretary of Defense to develop an integrated Ballistic Missile Defense System that would be a layered system of components working together

capable of defending against all classes and ranges of threat ballistic missiles in all flight phases. Because the integrated Ballistic Missile Defense System is a large program made up of many projects implemented over time on a worldwide basis, MDA has determined that a programmatic NEPA analysis would be appropriate. Therefore, the MDA has prepared a Programmatic EIS to analyze the environmental impacts of implementing the proposed program.

The Programmatic EIS, or PEIS, analyzes the broad environmental consequences in a wide-ranging federal program like the Ballistic Missile Defense System.

The PEIS looks ahead at the overall issues in a proposed program and considers related actions together in order to review the program comprehensively.

The PEIS is appropriate for projects that are broad in scope, are implemented in phases, and are dispersed widely geographically.

A PEIS creates a comprehensive, global, analytical framework that supports subsequent analysis of specific activities at specific locations.

The Programmatic EIS is intended to serve as a tiering document for subsequent specific

Ballistic Missile Defense System analysis and includes a roadmap for considering impacts and resource areas in developing future documents.

This roadmap identifies how a specific resource area can be analyzed and also includes thresholds for considering the significance of environmental impacts to specific resource areas.

This means that installations, ranges, and facilities at which specific program activities may occur in the future could tier their documents from the PEIS and have some reference point from which to start their site-specific analysis.

The Ballistic Missile Defense System Programmatic EIS analyzes the potential environmental impacts of developing, testing, deploying, and planning for decommissioning for the proposed program.

The Programmatic EIS evaluates the proposed Ballistic Missile Defense System technology, components, assets, and programs, and considers future development and application of new technologies.

The proposed action considered in the BMDS Programmatic EIS is for the MDA to develop, test, deploy, and plan for decommissioning activities for an integrated Ballistic Missile Defense System using existing infrastructure and capabilities, when

feasible, as well as emerging and new technologies to meet current and evolving threats.

When feasible, the MDA would use existing infrastructure to implement the BMDS and would incorporate new technologies and capabilities as they become available. This would ensure that the program could provide defense for both current and future ballistic missile threats.

The purpose of the proposed action is to incrementally develop and deploy a Ballistic Missile Defense System, the performance of which can be improved over time, and that layers defenses to intercept ballistic missiles of all ranges in all phases of flight.

The proposed action is needed to protect the United States, its deployed forces, friends and allies, from ballistic missile threats.

In this Programmatic EIS, the MDA considered two alternative approaches to implementing the Ballistic Missile Defense System. We also considered a No Action Alternative. The alternative approaches address the use of methods from land-, sea-, air-, and space-based platforms.

Alternative 1 is to develop, test, deploy, and plan to decommission an integrated Ballistic

Missile Defense System that includes land-, sea-, and air-based weapons platforms.

The BMDS envisioned in Alternative 1 would include space-based sensors, but would not include space-based defensive weapons.

Alternative 2 is to develop, test, deploy, and plan to decommission an integrated Ballistic Missile Defense System that includes land-, sea-, air-, and space-based weapons platforms.

Alternative 2 would be identical to 1, with the addition of space-based defensive weapons.

The Council on Environmental Quality regulations implementing NEPA also require consideration of the No Action Alternative. Under the No Action Alternative, the MDA would not develop, test, deploy or plan for decommissioning activities for an integrated Ballistic Missile Defense System.

Please note that under the No Action Alternative, MDA would continue existing development and testing of individual elements as stand-alone defensive capabilities. Individual systems would continue to be tested but would not be subjected to system integration tests.

Alternatives 1 and 2 provide different weapons platforms options for implementing an

integrated Ballistic Missile Defense System, while the No Action Alternative continues the traditional approach of developing individual missile defense elements such as the Airborne Laser, Patriot, or ground-based interceptors.

I will now address how MDA categorized the Ballistic Missile Defense System into relevant components and life cycle activities that could be considered to provide a programmatic overview of the environmental impacts of implementing the proposed action.

MDA's goal is to develop an integrated Ballistic Missile Defense System that will provide a layered defense. The Ballistic Missile Defense System would be capable of destroying threat missiles in the boost, midcourse, and terminal phases of flight and would defend against short, medium, intermediate, and long-range threat ballistic missiles.

Finally, the Ballistic Missile Defense System would integrate sensors and weapons through a command control, battle management, and communications network, or C2BMC.

With this capability, the integrated Ballistic Missile Defense System would establish a defense against threat ballistic missiles.

The Ballistic Missile Defense System is a complex system of systems. To be able to perform a meaningful impact analysis, we considered the Ballistic Missile Defense System in terms of its components: weapons, sensors, C2BMC, and support assets.

These components are the building blocks that can be assembled with specific functional capabilities and can be operated either together or independently to defeat threat ballistic missiles.

Testing was considered for each component; however, the integrated Ballistic Missile Defense System needs to be tested at the system level, and thus was analyzed using realistic system integration flight test scenarios.

Let's look at each of the components.

The Ballistic Missile Defense System weapons would provide defense against threat ballistic missiles. They include interceptors and directed energy weapons in the form of high-energy lasers that would be used to negate threat missiles.

Interceptors would use hit-to-kill technology, either through direct impact or directed fragmentation. Ballistic Missile Defense System weapons are designed to intercept threat ballistic

missiles in one or more phases of flight and could be activated from land-, sea-, air-, or space-based platforms.

The Ballistic Missile Defense System sensors would provide the relevant tracking data for threat ballistic missiles. Sensors detect and track threat missiles and assess whether a threat missile has been destroyed. Sensors provide the information needed to locate and track a threat missile to support coordinated and effective decision-making against the threat.

There are four basic categories of sensors considered for the Ballistic Missile Defense System. They are radars, infrared, optical, and laser sensors.

Radars send out a signal and detect the same signal as it bounces off an object.

Infrared sensors are passive sensors that detect and track heat or infrared radiation from an object.

Optical sensors are passive sensors that collect light energy or radiation emitted from an object.

Laser sensors use laser energy to illuminate and detect the object's motion.

Radars and lasers, thus, emit radiation,

while infrared and optical sensors detect radiation that has been emitted.

The Ballistic Missile Defense System sensors would operate from multiple platforms, such as land, sea, air or space.

The data collected by the sensors would travel through a communication system to command and control centers where a battle management decision on whether to use a defensive weapon would be made.

C2BMC would integrate and coordinate equipment and operations throughout command and control and integrated fire control centers.

C2BMC would enable military commanders to receive and process information, make decisions, and communicate those decisions regarding the engaging of the threat missiles.

The C2BMC would include fiber optic cable, computer terminals, and antennas, and would operate from land-, sea-, air- and space-based platforms.

The last category of components is support assets.

Support assets would be used to facilitate development, testing, and deployment of the Ballistic Missile Defense System components.

Support assets are one of three types:

support equipment, infrastructure, or test assets.

Support equipment includes general transportation and portable equipment such as automobiles, ships, aircraft, rail, and generators.

Infrastructure includes docks, shipyards, launch facilities, and airports.

Test assets include test range facilities, targets, countermeasure devices, simulants, and observation vehicles.

Now that we have discussed the components, Mr. Marty Duke will continue and describe how they can be integrated into a Ballistic Missile Defense System.

MR. DUKE: This slide depicts the integration of the various components of the proposed BMDS that Colonel Graham just discussed.

The use of multiple defensive weapons and sensors operating from a variety of platforms integrated through a single C2BMC system would create a layered defense allowing several opportunities to intercept and destroy the threat missile.

For example, one weapon could engage a threat missile in its boost phase, which is represented in the red here, and another could be used to intercept the threat missile in a later phase if the initial intercept attempts were unsuccessful

either in the mid or in the terminal phase here.

Components are incorporated into the BMDS through the life cycle phases of the system acquisition process.

These life cycle phases are development, testing, deployment, and decommissioning.

New components would undergo initial development testing, while existing components would be tested to determine their readiness for use.

Work on a given technology would stop if testing failed to demonstrate effectiveness or if the functional capability needs changed.

Components and elements would be deployed as testing demonstrates that they have capabilities of defending against threat ballistic missiles. In most cases, that component would be deployed when testing demonstrates that it's capable of operating within the integrated BMDS and the associated safety and health procedures are developed and adequate.

This process concludes with decommissioning, which would occur when and where appropriate.

To determine the environmental impacts, this PEIS analyzes the proposed BMDS components by considering the various life cycle phase activities of

each component as well as the operating environments in which the activities take place.

This slide tries to depict the multi-dimensional complexities involved in considering the impacts of implementing an integrated BMDS in terms of its components, which we represent here - the weapon sensors, C2BMC, support assets - across each of their life cycle phase - development, test, deploy, decommissioning - in the different operating environments.

Because of the complex nature of this project, an analysis strategy was developed to effectively yet efficiently consider the broad range of environmental impacts from the proposed BMDS.

First, the existing conditions of the effective environments were characterized for the location where various BMDS activities are proposed to occur.

Next, MDA determined the resource areas that could potentially be affected by implementing the BMDS.

Finally, impacts of the BMDS were analyzed in four steps.

In Step 1 we identified and characterized life cycle phase activities.

In Step 2 we identified activities with no potential for impact and dismissed them from further analysis.

In Step 3 we identified similar activities across life cycle phases and combined them for the analysis.

And, finally, in Step 4 we conducted the impact analysis for all remaining activities.

The first three steps were used to characterize and reduce the number of unique life cycle activities, thereby reducing the redundancy in preparing the impact analysis.

The affected environment includes all land, air, water, and space environments where proposed BMDS activities are reasonably foreseeable.

The affected environments have been considered in terms of broad ocean area, the atmosphere, the nine terrestrial biomes.

A biome is a geographic area with similar environments or ecologies.

Climate, geography, geology, and the distribution of vegetation and wildlife determined the distribution of these biomes.

These biomes encompass both the U.S. and non-U.S. locations where the BMDS could be located or

operated.

The resource areas considered in this analysis are those resources that can potentially be affected by implementing the proposed BMDS.

NEPA analysis generally considers the resource areas listed on the screen, except for orbital debris. Because missile defense development and test activities include the launch and the intercept of missiles, space-based communications and other satellites, and potential for space-based interceptors, MDA also considered orbital debris and its impact on the Earth.

This PEIS discusses all resource areas, provides a methodology for analysis, and suggests thresholds of significance to provide the reader with a roadmap for performing future site-specific analyses tiering from this PEIS.

These discussions outline the type of information that would be needed to conduct site-specific analyses and identifies the steps necessary to ensure potential impacts are appropriately considered.

The resource areas, highlighted with the red star, require site-specific information for analysis, and these resource areas are more

effectively addressed in subsequent tiered analyses for specific activities.

Once we decided how to consider the effective environment and resource areas of concern, we used the four-step process I just mentioned earlier. I will discuss each step with more detail.

In Step 1 of the impacts analysis, MDA identified and characterized the activities associated with each BMDS component.

Each life cycle phase has activities applied to each component. For example, development can include planning, research, systems engineering, site preparation and construction.

Testing can include manufacturing, site preparation and construction, transportation, activation, and launch activities.

Deployment can include manufacturing, site preparation and construction, transportation, activation, launch, operation and maintenance, upgrades, and training.

And, finally, decommissioning includes demilitarization and disposal.

Once life cycle activities were identified, it was determined that some of these activities had no potential for impact. Activities

such as planning and budgeting, systems engineering, and tabletop exercises, are generally categorically excluded in various Department of Defense NEPA regulations and therefore were not further analyzed in this PEIS.

Other activities for specific components, such as transportation, maintenance and sustainment, and manufacturing, were not analyzed in this PEIS because they've been evaluated in previous NEPA analyses and have been found to have no significant environmental impacts.

The remaining activities were then examined to determine which activities had similar environmental impacts. For example, impacts associated with site preparation and construction in the development phase would be similar to or the same as the impacts for site preparation and construction activities in the deployment phase.

Under Step 3, similar activities occurring in different life cycle phases were identified and considered together to reduce redundancy.

The final step was to determine the impacts associated with each remaining activity under the proposed action.

The significance of an impact is a

function of the nature of the receiving environment and the receptors in that environment. For example, an interceptor launch creates the same emission no matter where it's launched. Whether those emissions cause impacts and the significance of those impacts depends upon the environment into which they are released.

The PEIS analyzes these emissions by components for each resource area and life cycle activity where potentials for impacts were identified.

Impacts were distinguished based upon the different operating environments: land, sea, air and space.

The analysis also considered specific impacts for individual biomes where activities could occur.

The impacts of system integration testing were considered separately from the impacts of individual component testing because integration testing would involve using multiple components in the same test.

To deal effectively with integration testing, MDA looked at two generic system integration flight test scenarios which involved different numbers of launches and intercepts.

The impacts analysis for Alternative 1 considers the use of land-, sea-, and air-based platforms for BMDS weapons. The analysis includes the use of space-based sensors, but not space-based weapons. The analysis is specific for each resource area based on the impacts from the activities associated with the BMDS component.

The impacts analysis for Alternative 2 includes the use of interceptors from land-, sea-, air-, and space-based platforms for BMDS weapons.

The impacts associated with the use of interceptors from land, sea, and air platforms would be the same as those discussed under Alternative 1; therefore, the analysis for Alternative 2 focuses on the impact of using interceptors from space-based platforms.

Therefore, the fundamental difference between Alternative 1 and 2 is that Alternative 2 includes the analysis of space-based platforms for interceptors.

The cumulative impacts of implementing the BMDS were also considered. Cumulative impacts are defined as impacts that result from the incremental impacts of the proposed action when added to other past, present, and reasonably foreseeable future

actions.

Because this proposed action is worldwide in scope and potential application, only activities similar in scope have been considered for cumulative impacts.

Under Alternative 1, worldwide launch programs for commercial and government programs were determined to be similar activities and similar in scope; therefore, the impacts of BMDS launches were consider cumulatively with the impacts from other worldwide government and commercial launches.

Alternative 2 includes placing defensive interceptors in space, which involves adding additional structures to space for extended periods of time.

The International Space Station was determined to be an action that is international in scope and has a purpose of placing structures in space for extended periods of time; therefore, the impacts of the use of space-based weapons platforms were considered cumulatively with the impacts of the International Space Station.

The next few slides provide broad summaries of the impacts analysis with the BMDS components and Test Integration for Alternatives 1 and

2, the No Action Alternative, and the Cumulative impacts for Alternative 1 and 2.

Please note that these results are extremely high level suitable for this presentation. Additional details have been provided in some of the posters in the back of the room. The impact analysis may also be found in the Executive Summary Impact tables in Section 4 of the Draft PEIS.

And we also have the Executive Summary available in the back of the room.

It is important to note that no environmental showstoppers were found in this programmatic impact analysis.

As the next few slides show, there are potential impacts associated with the various activities needed to implement the BMDS; however, they would be appropriately addressed in subsequent tiered NEPA analyses, along with the mitigation actions required to ensure less than significant impacts.

This slide shows a summary of the broad potential for environmental impacts associated with the BMDS weapon activities as examined for each resource area for Alternatives 1 and 2.

Please note again that this is a very high-level depiction of the results of the analysis,

and additional details of the weapons analysis may be found in the table in the Executive Summary.

However, one can see from this slide the general activities and resource areas that would be considered in subsequent tiered NEPA analyses.

This slide shows the impacts summary for the BMDS sensors. Note that the impacts are the same for Alternative 1 and 2 and include space-based sensor platforms. This summary also shows how MDA's categorization of activities helped to simplify the analysis.

For example, the activation of radars would not impact air quality because the only emissions resulting from radars would be from the supporting diesel generators, which are addressed under the support assets. However, radars do generate electromagnetic radiation and could potentially impact biological resources.

Although C2BMC is the glue that enables the integrated BMDS to function effectively as a system, this component creates little potential for environmental impact.

Impacts associated with Support Assets are mainly those that would be caused by site preparation and construction of infrastructure and by using test

assets such as countermeasures and simulants during testing.

Test Integration overall has the potential for impacts because it includes the use of several components during increasingly realistic test scenarios. Although this programmatic analysis shows the potential for impacts, the existing environment at the proposed test location and the specific test activity planned will determine the nature and the extent of these impacts.

The No Action Alternative would continue the development and testing of individual weapons, sensors, C2BMC, and support assets, and would not include integration testing of these components.

The environmental impacts of the No Action Alternative would be the same as the impact resulting from continued development and testing of the individual missile defense elements.

The decision not to deploy a fully integrated BMDS could result in the inability to respond to a ballistic missile attack on the U.S. or its deployed forces overseas, our allies or friends, in a timely and successful manner.

Further, this alternative would not meet the purpose or the need of the proposed action or the

specified direction of the President and the United States Congress.

We examined the impact of the worldwide launches on the cumulative impacts. Launches can create cumulative impacts by contributing to global warming and ozone depletion. Potential launching emissions that could affect global warming include carbon monoxide and carbon dioxide or CO_2. Unlike CO_2, carbon monoxide is not a greenhouse gas, but it can contribute indirectly to the greenhouse gas effect.

The cumulative impact on global warming of emissions from BMDS launches would be insignificant compared to the emissions from other industrial sources, such as energy generation.

The BMDS launch emissions load of CO_2 and carbon monoxide would only be five percent of the emissions load from worldwide launches. In addition, CO_2 and carbon monoxide from ten years of BMDS worldwide launches combined would account for much less than one percent of the CO_2 and carbon monoxide emissions from U.S. industrial sources in a single year.

Chlorine is of primary concern with respect to ozone depletion. Launches are one of the manmade sources of chlorine in the stratosphere. The

cumulative impacts on stratospheric ozone depletion from launches would be far below the effects caused by other natural and manmade sources.

The emission loads of chlorine from both BMDS and other launches worldwide occurring between 2004 and 2014 would account for only about half of one percent of the industry chlorine load from the U.S. in a single year.

The orbital debris produced by BMDS activities would generally be small in size and would consist primarily of launch vehicle hardware, old satellites, bolts, and paint chips.

It may also be possible for debris from an intercept to become orbital debris. However, orbital debris produced by BMDS activities would occur in low-earth orbit where debris would gradually drop into lower orbits and reenter the atmosphere; therefore, orbital debris from BMDS activities would not pose a long-term hazard to the International Space Station or other orbiting structures.

In addition, collision avoidance measures would further reduce the potential for orbital debris to damage structures in space, such as the International Space Station.

I would like to reiterate that our impacts

analysis indicated no expected areas of significant impacts on the environment. However, many resource areas show potential for impact, indicating that these areas need to be considered in any subsequent analyses tiered from this PEIS at a site-specific location.

At this time I'd like to turn the meeting back over to Peter who will discuss some more about how we're going to do the administrative comments later on into the meeting.

MR. BONNER: Now that we've looked at the proposed BMDS and the potential impacts from implementation, let's discuss the PEIS schedule for a minute.

The PEIS development process began with the Notice of Intent, or NOI, which was published on April 11th, 2003.

The MDA released the Draft PEIS in September of 2004. The public comment period, that we're in right now, will continue through November 17th, 2004. At that time, the MDA will consider all the comments received and incorporate appropriate changes into the Final PEIS.

A release date for the Final PEIS is estimated for December 2004 or January 2005.

After the release of the Final PEIS, there

will be a 30-day waiting period before MDA can issue its Record of Decision, or ROD.

There are a number of ways you can submit comments and provide comments on the Draft BMDS PEIS. You can provide your comments either orally or in writing. Both oral and written comments will be given equal consideration in the final PEIS.

If you'd like to make a statement at tonight's meeting, please sign up at the registration table and fill out a speaker's card. Each speaker will have an initial five minutes to make a statement. This five minutes is your time. If you need significantly more time than five minutes, I'd ask that you yield to the other speakers and then come back after the final speaker has spoken and provide additional input.

As mentioned earlier, public statements by tonight's speakers will be recorded by the court reporter to ensure that we can accurately capture your comments. There's also a toll-free telephone number that you may use to submit comments, and please refer to your handouts for that.

The information on the screen lists the various ways you can submit your comments to us. The information is also listed in the comment form at the

registration table, the MDA website, and handouts available in the poster area.

Another option to submit your comments is in writing. There are four ways to do that. First, you may leave your written comments you brought with you tonight with us at the registration table. Second, you can use the comment forms that we have available at the registration table, and you can either turn them in to us or fax or e-mail them to us.

You may also e-mail your comments using the MDA address listed in the handouts and on the website. Finally, you can submit your comments through the website on an electronic form there.

Again, to ensure that your comments are adequately considered, please get them to us by November 17th.

Please visit the BMDS PEIS website for additional information. The website provides fuller descriptions of the topic areas that we touched on this evening, as well as links for obtaining additional information.

The material handed out tonight are also posted on the BMDS PEIS website.

We encourage you to sign up to receive a hard copy of the Executive Summary of the Final PEIS

and a CD-ROM of the whole document when it becomes available. To do this, please fill out the appropriate form at the registration table.

You can also request the Executive Summary or CD-ROM of the entire document by sending an e-mail to the address listed in the handout materials.

The final PEIS will be available in PDF format to download from the website, and hard copies will be placed in local libraries. A list of these libraries, again, is available on the website.

Please remember that no decision on the project will be made tonight. Our role is to listen to your concerns and issues firsthand and ensure that they're considered in the Final PEIS.

To ensure that all comments are addressed in the Final PEIS, again, we'd like them submitted no later than November 17th.

At this point we'd like to take a fifteen-minute break to set up for public statements. Please use this time to sign up at the registration table if you're interested in providing a public comment. Please also note that the MDA staff will be available to answer questions immediately following the conclusion.

TERRI KEKOOLANI: I have a question.

MR. BONNER: Yes?

TERRI KEKOOLANI: Who present here is going to be your Hawaiian language translator?

MR. BONNER: I don't think we've provided for one, unfortunately.

MR. DUKE: Has there been a request?

TERRI KEKOOLANI: Please note that you don't have one.

MR. BONNER: Thank you. Let's take our fifteen-minute break where you can sign up for public comment.

KYLE KAJIHIRO: I also have questions about the process. That was one of my questions. The other one had to do with the schedule of hearings. There's only one hearing on Oahu and we had requested at the scoping meeting that there be meetings on Kauai and Maui, because those are islands that are also affected. It's very expensive to fly over here, and you haven't scheduled those, so I'd like to know why not, you know, and because the reason is you're actually discriminating against native Hawaiians in doing so.

As William Eiler has said in other testimony, Hawaiian culture is an old tradition, so to be able to testify in person, orally, is very

important, and if you don't provide that opportunity, you've effectively discriminated against a whole segment of the community. So can you answer that, please?

MR. BONNER: I think that was considered as part of the schedule in moving forward and it was considered by MDA and the folks who had made the decisions on where to schedule these, that these locations would be sufficient.

Marty, would you like to comment on that any further?

MR. DUKE: We take everything considered. Since this is a very programmatic document, it's not site-specific on particular ranges, it's just BMDS in general, the integration of BMDS, we looked at the states that had most of our activities and we decided to meet in the Capitols of those states.

Now, comments can be made through the various means. And written comments, e-mail comments, hold the same weight as public comments.

TERRI KEKOOLANI: I'm sorry, I have to interrupt. Isn't this going to be based on Kauai? When you say the Capitol of the state, they can't drive here, so when you --

MR. DUKE: We have other means to make the

comments through --

TERRI KEKOOLANI: How are they seeing your presentation?

MR. DUKE: Well, I guess they are not seeing our presentation, but we have the information out on our website and other means.

TERRI KEKOOLANI: So the people who are directly impacted by this particular program are not actually seeing your presentation?

MR. DUKE: No, they are not seeing our presentation.

KYLE KAJIHIRO: You're missing the point I'm making, which is that for many in the native Hawaiian community, they're an oral tradition, so to deny the opportunity for direct oral comments is to basically cut them out of the process completely.

MR. DUKE: When we published --

KYLE KAJIHIRO: That's a serious flaw in this entire thing.

MR. DUKE: Well, since we drafted and published the Draft PEIS from your previous comments, we've had no other requests from anyone from the islands requesting we have a different location.

KYLE KAJIHIRO: There were only three of us who actually found out about this scoping meeting. It was

at a very hard-to-find location, and I think that that's been the pattern with these hearings related to the missile defense program is that they have been very hard to get to, very inaccessible, and that really discriminates against the communities that are most affected. And that's a concern that I have, that I think it questions and undermines the integrity of the whole process.

My name is Kyle Kajihiro.

MR. BONNER: Let me make a suggestion, that comments about process are certainly well within and appropriate for the public comment period. Let's move to the public comment period and get your comments about the process or about the PEIS or comments about the BMDS during that process, okay?

Please sign up at the registration table if you'd like to. Thank you.

So we're going to take fifteen minutes. Give you an opportunity to sign up, come back and make the public comments.

(Recess at 7:18 p.m. until 7:33 p.m.)

MR. BONNER: I have the list of speakers who have registered. I'll call each person to the front of the room to the microphone to speak. Again, please limit your initial comments to five minutes. If you'd

like to extend those comments later on, if you could wait until the final speaker has finished and then come back and provide additional input, that would help us.

At the end of about four minutes I'm going to hold up a sign that says "one minute" on it to give you a chance to wrap up. If you have a written version of your comments, we ask that you provide it to us to facilitate an accurate record.

When providing your public statement, please remember to state your name, if you have an affiliation with an organization, we'd like that too, and speak as clearly as you can for the meeting recorder.

If you don't wish to make an oral statement here tonight, please consider providing your comments in writing to us through the avenues we talked about.

Again, thanks for your participation in the process.

Could I have Seiji Yamada come up?

DR. SEIJI YAMADA: My name is Seiji Yamada and I'm a physician, a public health worker, and an educator. I would like to submit comments on the effects that the testing of the Ballistic Missile

System has had on the society and health of the people of the Marshall Islands.

Kwajalein Atoll in the Marshall Islands is the site of the Ronald Reagan Ballistic Missile Defense Test Site. The RTS is equipped to track ICBMs launched from California and to launch the interceptor missiles being testing for the BMDS. I speak from my observations on a number of medical visits to Kwajalein Atoll.

The current testing of the BMDS follows upon the use of the Marshall Islands for nuclear weapons testing. From 1946 to 1957, the U.S. tested 67 nuclear weapons in the Marshall Islands. The 15 megaton Bravo blast of 1954 was America's largest. It rendered Bikini uninhabitable and exposed the people of Rongelap and Utrik to nuclear fallout. Many suffered from acute radiation sickness, and Marshallese have high rates of thyroid cancer.

Displaced by weapons testing, the people of Enewetak, Rongelap, and Bikini have been forced into nomadic lives.

Depending on the level of activity on the base, two to 4,000 non-Marshallese live on Kwajalein Island, the largest and nicest island in Kwajalein Atoll. Most of the residents are employees of U.S.

contractors.

Kwajalein has wide-open spaces and streets shaded with trees. The stores are well-stocked and the grocery store carries fresh fruit and vegetables. The grounds are kept up by Marshallese men, and linens on the beds are changed by Marshallese women.

Marshallese workers on Kwajalein arrive on the ferry from nearby Ebeye Island in the morning, and must return there within three hours of completing their shifts.

Ebeye Island, where the Marshallese people live, is three miles and a twenty minute ferry ride from Kwajalein Island. Its 66 acres are home to 10,000 people. Some people are from Enewetak, Rongelap, and Bikini, displaced by nuclear testing. Some were residents of the central corridor of islands within Kwajalein Atoll, displaced by missile testing. Jobs at the RTS have brought people to Ebeye from all over.

On Ebeye, many of the private houses are made of corrugated tin and plywood. There's little greenery on the island. There's no space for crops. During the rains, the sewage backs up. The electricity goes out occasionally for extended periods. So people subsist on imported white rice and

canned meats with little access to fresh vegetables or fruits. The result is undernutrition in children, malnutrition, Vitamin A deficiency. The crude prevalence of diabetes in adults over 30 years of age is 20 percent.

The hospital often lacks basic medical supplies, and until 2001 did not have running water. Also until 2001 boys and young men met the ferry with containers to carry water from Kwajalein to Ebeye. Such difficult water conditions led to a cholera epidemic on Ebeye in December 2000. There were over 400 cases and six people died.

The racism inherit in the apartheid-like Kwajalein-Ebeye setup is palpable for the Marshallese people. Indeed, racism was inherit in the decision to conduct nuclear and ballistic missile testing in the Marshall Islands in the first place. After all, who would willingly volunteer their home to be a target for missiles shot from another continent?

Finally, I would like to note that the Ballistic Missile Defense System is only one component of the militarization of space. The goal is the absolute military superiority of the U.S., allowing it to act with impunity around the globe. Missile defense is about preserving America's ability to wield

power abroad. It is not about defense. It is about offense.

As noted in Vision 2020, a document produced by the U.S. Space Command, the goal is full-spectrum dominance, including precision-strike capability.

While space-based strike weapons are not yet a reality, cruise missiles are. Some 800 Tomahawk cruise missiles were utilized at the start of the assault on the people of Iraq in March 2003 in a strategy called Shock and Awe.

This is more than was used during the entire First Gulf War. Strategist at the National Defense University, Harlan Ullman, touted Shock and Awe on CBS TV prior to the assault. He said we want them to quit. We want them not to fight. This will have the desired simultaneous effect, rather like the nuclear weapons at Hiroshima, not taking days or weeks but in minutes.

I'm from Hiroshima, and it's hard for me to comprehend Hiroshima being cited in a positive manner.

MR. BONNER: You've got about a minute left for your five minutes.

DR. SEIJI YAMADA: Between 5,000 and 10,000

Iraqi civilians and between 4,000 and 7,000 Iraqi military personnel were killed during the period of the initial assault. This is the suffering caused by such weapons. We cannot continue to let this happen.

Thank you.

(Applause.)

MR. BONNER: Thank you.

Will Michael Jones come up?

MICHAEL JONES: I have a few comments to make about deficiencies in this, and some of these were deficiencies in previous analyses.

There's no examination of treaty restriction on target launches in this EIS, no quantitative information on the reliabilities of rocket boosters. There's some inconsistencies and confusion about cumulative impacts. This EIS estimates 515 launches in a ten-year period, the previous 2003 ground-based missile defense extended test range EIS estimated only 100 in a ten-year period.

There's an egregious error in Exhibit 4-11 on page 4-102. First of all, there's an addition error in the table. The more serious error is that total emissions for the interceptor are given as 115 kilograms, whereas the 2003 EIS for the ground-based interceptor gave the first stage emissions as 15,000

kilograms. So what's given in this EIS is a factor of 100 too small.

Probably the most serious problem is that this document is largely irrelevant.

As the summary in Section 1.2 indicates, environmental analyses have been done for most of the components already. Notable exceptions are sea-based midcourse defense and space weapons, which to my knowledge have not been analyzed.

R&D and testing of most of the components is well underway and decisions have mostly been made about these systems, including even decisions about the initial deployment of the ground-based midcourse defense and the sea-based midcourse defense.

The No Action Alternative is not seriously considered. It is claimed not to be at the direction of Congress, presumably the 1999 Missile Defense Act. This Act states U.S. policy is to deploy as soon as is technologically possible an effective NMD system, but the EIS has no discussion about NMD effectiveness and whether that criteria is satisfied.

Finally, the spiral development approach seems to preclude any meaningful assessment. The PEIS could make an useful contribution by analyzing how to judge the effectiveness of the missile defense with no

specified architecture and no operational requirements.

Thank you.

(Applause.)

MR. BONNER: Elayne Pool?

ELAYNE POOL: I have a letter that's been signed by 36 people and myself and I would like to read that to you, please.

We support a real No Action Alternative to the deployment of a missiles defense system. This means no further testing, development or deployment.

Deployment of such a system threatens a new nuclear arms race, puts the global environment at risk, and does not improve the security of the United States.

Deployment of a missile defense system will increase the likelihood of a nuclear catastrophe. It impels Russia to maintain a larger nuclear arsenal on high alert than it otherwise would.

Deployment also drives China to deploy a larger arsenal. The impact of a nuclear war, whether accidental or intentional, would dwarf any other environmental nightmare one can envision.

Moreover, the system does not improve our security. So far it has yet to be tested in realistic

conditions and would be ineffective against an attack.

While in the future the capabilities of this system can be expanded at great expense, these developments are likely to be made useless by the newly improved weapons and countermeasures of potential adversaries.

Finally, the $10 billion a year being spent on missile defense should be spent on measures that are more effective and environmentally sound. One example is the program to secure stockpiles of nuclear weapons material in the former Soviet Union and other countries.

The testing, development, and deployment of the missile defense system should be halted, given that the system leads to environmental harm and potentially to environmental devastation and does so without improving the security of the United States.

Finally, I'd like to read a statement, and I wonder if you know who said it. These words certainly apply to this costly system that is untested and will endanger mankind further.

"Every gun that is made, every warship launched, every rocket fired, signifies in the final sense, a theft from those who hunger and are not fed, those who are cold and are not clothed.

"The world in arms is not spending money alone. It is spending the sweat of its laborers, the genius of its scientists, the hopes of its children.

"This is not a way of life at all, in any true sense. Under the cloud of threatening war, it is humanity hanging from a cross of iron."

That was said by Dwight Eisenhower, Five Star General of the U.S. Army and the United States President.

(Applause.)

MR. BONNER: Thank you.

Kyle Kajihiro?

KYLE KAJIHIRO: Aloha. I am Kyle Kajihiro. Thank you for this opportunity to testify. I am representing the American Friends Service Committee this evening, Hawaii area program, and we're opposed to the Ballistic Missile Defense System completely.

I think that you have inadequate alternatives. You only have three alternatives and there ought to be a fourth one which includes not deploying, developing the Ballistic Missile Defense System, and actually reducing the scope of existing programs.

That should be considered as a real alternative for considering what is really in the

interest of the United States and the world in terms of building a real security environment.

I want to first just go back to the question of the process being flawed so it can get on the record.

Again, I think that these processes have typically discouraged public participation. Whether that's by design or just by negligence, I think that it needs to be noted that there haven't been adequate efforts to reach out to the public, to provide accessible venues and opportunities for people to testify.

As I said earlier, as Terri Kekoolani said earlier, Hawaiian translation is essential, the native Hawaiian language, Olelo Hawaii, is one of the official languages of Hawaii, and that should be honored in these proceedings so that when Hawaiian words are expressed, they are captured correctly and not noted as inaudible or unintelligible, which is often the case.

Second, the question of native Hawaiian culture being an oral tradition, it's very important that you provide opportunities for people to give live testimony where they can look you in the eye and express what they are feeling.

When you say that often written testimony or e-mail testimony is adequate, you effectively discriminate against a whole group of people who are actually one of the groups that are disadvantaged and should be considered as part of the environmental justice analysis of your Environmental Impact Statement.

The missile defense program we believe violates international treaties and is destabilizing in this global environment. As others have said, it will increase the likelihood of nuclear catastrophe by creating nuclear rivalries and forcing other countries to build up their arsenal.

In July 2001 the Russian foreign ministry spokesperson, Alexander Yakovenko reacted very angrily to the U.S. missile defense tests over the Pacific. He warned that the missile defense contributes to a situation which "threatens all international treaties in the sphere of nuclear disarmament and nonproliferation which are based on the 1972 Anti-Ballistic Missile Treaty."

On June 13, 2002, George W. Bush unilaterally and without the vote of Congress withdrew the United States from the ABM Treaty.

So I think that if the United States is

going to be a leader of the world in terms of establishing policy for peace and democracy, it needs to demonstrate that by its own actions, and instead it's only demonstrated a policy of aggression.

The nuclear posture is now to consider the possible use of limited nuclear strikes. That's a very dangerous step from past nuclear doctrine, and combined with the missile defense system is seen as a threat to many countries around the world.

So I don't think you can separate the missile defense system from the rest of the nuclear doctrine. It has to be considered together. And in that light, missile defense is an offensive weapon, as others have said, to establish U.S. full-spectrum dominance.

So the Programmatic EIS fails to analyze how the proposed BMDS system will affect the international security environment, how will it impact international laws and treaties such as prohibitions on the weaponization of space. And that's one of the explicit options for the Ballistic Missile Defense System. So that goes against established agreements to keep space for peace.

I want to also speak about the opportunity costs. As someone testified earlier, what we spend on

missile defense and other military spending is stealing from the dreams of our children, the potentials of our community.

I want to give you an example of how this would affect us here in the Hawaii, according to the National Priorities Project. Taxpayers in Hawaii will pay 33.1 million for ballistic missile defense in fiscal year 2005.

For the same amount of money, the following could be provided: 11,269 people receiving health care, or 4,426 Head Start places for children, or 17,466 children receiving health care, or 150 affordable housing units, or four new elementary schools, or 9,556 scholarships for university students, or 571 music and arts teachers.

So I say that that needs to be considered. The opportunity costs of ballistic missile defense is one of the impacts that we have to deal with and our children have to deal with, and it needs to be considered in your Environmental Impact Statement, and I didn't see it listed there.

The cumulative impacts analysis I think was very flawed. You said earlier that you would only consider similar types of global actions in comparing what the cumulative impacts would be, but I think

that's a way of effectively ignoring the combined effects of many, many local impacts that occur when you have these programs in many forms around the world. So I think you need to consider all those analyses, the local studies that are being done, that have been done, past, present and future.

And this also includes historical impacts related to colonialism. As others have expressed about the Marshall Islands, the U.S. program there has been devastating for that community. The same is true here in Hawaii for native Hawaiians; the 111 years that the U.S. military has invaded and destroyed Hawaiian land, culture, or denied people the ability to practice. Those also have to be considered as part of the cumulative impacts.

And this gets to the environment justice analysis, which is also flawed and inadequate.

There is an adverse and significant impact on native peoples here in Hawaii, in Greenland, Enewetak in the Marshall Islands, and in other places, Alaska and so forth, and you did not look at how this program has a disparate effect on those peoples, their culture, their resources, and actually their survival. So please consider those.

And, in closing, I urge you to scrap the

program. We oppose the ballistic missile defense, it's dangerous, it's wasteful, and the world will be much better off without it. Thank you.

(Applause.)

To add a little levity here to this program: It's been documented that the program is -- the missile defense system is easily fooled by decoys which resemble these mylar balloons in space, and because there's been so much, I think, misinformation or incorrect information about what the program actually is, we wanted to present you with this testimony that sort of documents some of the effects.

(Mylar balloons tendered.)

(Applause.)

MR. BONNER: Thank you.

We call Elma Coleman to come up and speak, please.

Let me make one short note before you start talking. If someone would like to give testimony in Hawaiian, we are taping this and while we don't have a live translator, we will provide the translation of that for the record, okay? Thank you.

ELMA COLEMAN: Does that mean I can give my testimony in Marshallese?

MR. BONNER: Yes.

ELMA COLEMAN: I'm from the Marshall Islands.

(Applause.)

MR. BONNER: Yes, absolutely.

ELMA COLEMAN: (*Speaking Marshallese - Hi everybody. My name is Elma Coleman and I am from the Marshall Islands. I am sitting and listening to the words you have said and I am very frustrated because there were so many scientific words used in your talking which are strange to me and I was not able to understand most of them, only a few were clear. I came here to talk and get some information in regard to some of the issues being discussed and the ones that I think are related to the Marshall Islands case that took place some fifty-one(51) years passed.*)

51 years since the nuclear Bravo exposed the people of Marshall Islands to nuclear fallout.

(*Speaking Marshallese - It's been 51 years passed. The people of Utrik and Rongelap did not know what to do when the nuclear testing was taking place at that time.*)

The people did not know what was happening. They didn't know how to deal with the nuclear fallout.

(*Speaking Marshallese - I, myself, would like to ask a question. What would you do if there were an accident affecting the lives of the Marshallese people by the nuclear testing?*)

Are they aware of what would they do if there's any accident with the missile testing?

(*Speaking Marshallese - Were there any studies ever made by you (Americans) about the nuclear testing in the Marshall Islands? If an island or and atoll is damaged by the testing, the problem won't affect the island only, but it will also affect the people of the whole Marshall Islands and the other Pacific Islanders as well. I am hearing all the words you are saying now, and I think it would be a better idea if you (Americans) could go there again and conduct more studies or do more research regarding the nuclear testing.*)

Conduct one hearing in the Marshall Islands. After all, that's where the missile testing is taking place.

(Applause.)

How come I'm reading here that the request was given to have the hearing posed or made on Kauai, Maui, and the Marshall Islands, and it was refused? These are the most affected places that are going to be most impacted.

(*Speaking Marshallese - The people have left their homes and made it easier for the Americans to do their testing on their islands. Is there anything the Americans could do now to return the people?*)

I don't think that's fair.

(*Speaking Marshallese - Is it safe for them to return?*)

Or at least reassure the people that there's not going to be any accident happening. But we cannot say that there's not going to be any accident. There's no guaranty. No matter what, there's no guaranty. And if something happens, what are the people going to do?

(*Speaking Marshallese - If you're using the missiles?*)

You know, I'm not sure what kind of chemical you use or you put in a missile testing or in the warhead when you intercept it in space, but all over the years that you have been doing the testing between Kwajalein and Vandenberg, has there been any environmental study of all the debris that has fallen down into the ocean to find out how contaminated the area is and how far spread the contamination is? Has there been anything done like that? And have the people been aware of what has been done or has not been done?

(Applause.)

MR. BONNER: Thank you.

Can we have Marti Townsend come up?

MARTI TOWNSEND: Aloha kakou. My name is Marti. I have a few points to make. The first are mostly legal, because I hope to God this EIS is put

through litigation.

First, notice and public hearing were inadequate. Although it's true that NEPA doesn't require them to hold a public hearing, it does require that the notice be on par with the extent of the program. And as they've clearly shown on their beautiful screen, this is supposed to have worldwide effect, yet we're only having, what, thirty of us here? I mean, this is affecting not only all of Hawaii, but all of the pacific and all of the entire world, and where was this hearing noticed in? Was it noticed on TV? Where did you guys hear about it? Word of mouth. I don't think notice was sufficient in this case, especially given the extent of this project.

In addition, as everyone has stated, there should be more hearings held. The three on the continent and the one here are just not sufficient.

In addition, the alternatives analysis is also inadequate. NEPA requires the alternatives to be considered, including the No Action Alternative, as has already been stated. That is sorely inadequate. But, in addition, you'll notice from reading the two alternatives, they're simply variations on a theme, they're one and the same thing.

And the reason for this, the reason why this is justified is because they're getting off on a technicality, because they stated that the purpose of this program or this project is to implement a Ballistic Missile Defense System. It's misleading, because really what this project is supposed to do, like the overriding principle, is to provide for the defense of the United States.

If you're going to provide for the defense of the United States, you need to talk about what are some real practical things that we should do or that Americans should do to protect themselves, and that includes, you know, not going over to other countries and blowing them up. We're actually talking about real diplomacy.

Unfortunately, this EIS doesn't do that, so, therefore, it's inadequate. I'm hoping that through litigation the technicality, like, can really narrowly define the purpose so that you don't have to do an extensive alternatives analysis, will end with this PEIS.

Also, the cumulative impact analysis is also inadequate. NEPA requires that past, present, and future activities that may incrementally add up to a cumulative impact on an area be assessed, but this

PEIS is flawed for several reasons. First, it doesn't really consider past projects in the cumulative impact analysis. It says something to the effect of, well, there are things that had gone through NEPA assessment before and so we're not considering those now.

This is obviously logically flawed. I mean, the EISs that we've gone through before, had any of them ever dreamed that there would be a missile defense thing shot from space? I mean, let's look at the Striker IS. We're all familiar with that. Does that mention at all anywhere ballistic missiles? No.

Okay. So clearly relying on a NEPA document published before this day is not going to give us an adequate analysis of whether it's a cumulative impact. In fact, there's a heck of a lot going on here caused by the military that never went through NEPA analysis.

Let's talk about use of Agent Orange on Oahu, okay? There's lots that needs to be assessed here, and to just cop out and say, well, there was once a NEPA document done, when we never even dreamed of shooting missiles from space, that's just not going to cut it.

In addition, they also put this really interesting limitation on it that I've never seen

before in an EIS, and I've read quite a few myself. It says, well, because this has a national and international nature to the impact of the ballistic missiles, they were only going to consider national/ international cumulative impacts. That means only something that affects the entire continent, only if it affects the entire world. So we're not going to look at the unique situation of Hawaii. And what we are having to go through is the increasing militarization of Hawaii, and that's not sufficient.

I mean, to really consider the cumulative impacts of this PEIS, we need to talk about things that are in the areas that are likely to be affected and likely to be caused harm.

In addition, the PEIS -- I guess I covered that point. Okay.

So the two main points are that past analysis is needed, we need to look at previous things that have been done in Hawaii and across the country or across the United States that have caused impacts, and then also the effect of not just national/ international impacts, but also of local impacts.

The rest of what I have to say is really like a wake-up call for people. Like I said, there's only what, thirty of us, maybe forty? This thing is

huge. We need to not let them take advantage of our trust, take advantage of our naivety. We need to get out there and talk to every person you know about this. This is huge. The only way that we're going to counteract this is not through these public hearings -- they are a great way to educate ourselves and connect with each other -- but what we need to do is talk to your Congress people, talk to your neighbors, vote, demonstrate, write letters to the editor, educate people about what they want to do.

Crap is going to fall from the sky. It's going to set on fire and it's going to land on the ground. They're going to be shooting hazardous materials from space. And CERCLA is mentioned once in the EIS. CERCLA is the hazardous waste law. Want to know where it's mentioned? In the table of contents, that's it. It's only mentioned in that list where they say, these are what all the abbreviations are. It's not anywhere else in the document.

So we need to organize. They really are playing on our trust and our ignorance about this process. They say stuff like, well, there's no unavoidable adverse impacts. I think Marty said something to the effect there's no, like, showstopper environmental impacts. Well, that's because they are

relying on a thing called best management practices.

Best management practices says that given whatever project you're involved in, you use the industry standard to make sure that you are abiding by whatever everybody else is doing. So if you're running a power plant, you look at what other power plants are doing and make sure you are doing the best thing environmentally for that.

Well, let's see. Who else is shooting missiles from space? Don't know. There's only one. Okay. So best management practices is whatever they want them to be.

So there are going to be unavoidable adverse impacts. We can't let them string us along like that. They use these words and these technical terms and people don't know what they mean. This stuff is just filled with technical jargon and we're forced to read 500 pages and make an informed decision about something.

They are using this process to sort of tell people who don't think we have the time to get involved because we're too busy being employed and trying to raise a family, they use this process to cover up the fact that we aren't really making an informed decision, that people are being taken

advantage of, and the law is being tweaked and used to their advantage to disempower us.

So although they may meet technical requirements of NEPA, we need to make people aware of the fact that they are not meeting the real requirements of NEPA and we aren't making an informed decision. Thank you.

(Applause.)

MR. BONNER: Thank you.

Will Julia Estrella come up?

JULIA ESTRELLA: Good evening. My name is Julia Estrella and I serve on the National Committee of the United Church of Christ, which deals with justice for Micronesians. It is with that hat on that I testify before your committee tonight.

As a member of the Micronesian Pronouncement Implementation Committee of the United Church of Christ, I have become aware of how the United States tested 67 nuclear bombs in the Marshall Islands from 1946 to 1958.

Now the United States' missile plan includes missile launches from Vandenberg Air Force Base in California to the lagoons of the Marshall Islands.

I am not a scientist, although my husband was a physicist, and therefore I do not understand all

the scientific terminology that they use in the EIS. In fact, as I was listening to all three of you make your presentation, I felt like I was an alien from another planet, as though -- I mean, we were totally in a different stratosphere as far as I was concerned. I felt pretty overwhelmed by your presentation and, actually, I began to feel like how the Marshallese folk must have felt when the military approached them and asked them to give up Bikini. I felt like you were saying this is good for mankind, trust us, we know what we're doing, and feeling overwhelmed. You know, I felt like I was being fooled. I felt like the decisions were already being made. How can you say no when probably the decisions are already made to move in this direction?

Anyway, I feel that I was glad to hear the previous speakers all talk about cumulative effects, because I think that is one of the weakest areas of your EIS. The cumulative effects on the Marshallese people, for example, who have already been exposed to so much nuclear poison and now you want to add more toxic waste into their lagoons. And the cumulation, the additive factors, I think you have not even touched on how this is going to impact a group of people that have already suffered enough for us

Americans.

So I think that if we're going to shoot at all, we should be shooting these missiles on the coast of Washington, D.C. I think that would be more fair in terms of cumulative effects on a group of people who have already taken too much of our nuclear and our toxic waste into the lagoons.

Also, I feel that instead of spending billions on an expanded missile defense program, I, like Kyle from AFSC, feel we should spend those billions on the needs of the people.

I work with people who live in public housing, as an organizer, and I see the people on a day-to-day basis who don't have enough food to eat, enough supplies for schools, who are on a survival basis. And here we're speaking about spending all these billions of dollars for what? You know, to me it's such a big waste of money, a big boondoggle. And who is benefitting from it? All the big defense contractors like Raytheon and all these multinational corporations. These are big bucks for the military contractors.

It's not fair, it's not just, and I think we need to realize that. Even in the EIS, we need to state something more clearly about the social impacts

and what it does to ordinary people who do not benefit from these kinds of programs. The rich are already getting richer. Why put more money into the pockets of these defense contractors?

Then, finally, I wanted to say that in your EIS I think you're misleading all of us by putting No Action as a third alternative. I think you need to be more honest and state specifically that No Action means to keep on testing as is without the integration.

I think that some of the people here felt like No Action meant that you were going to start dismantling the missile defense system, which, of course, should have been stated as another alternative, which you didn't even give us a chance to put down.

At first I was going to put No Action, and then I read where it says continue testing as is. And so please do not mislead us. Please state what you're really meaning when you say that's a third alternative. And please give us another alternative which says stop Star Wars, dismantle the missile defense system, start helping the people who really need the help, and let's bring peace instead of more destruction. Because as you were talking, you talked

about destroy this and intervene here, and we don't need more destruction. So in the EIS please focus on other than destruction.

Thank you.

(Applause.)

MR. BONNER: Thank you.

Ron Fujiyoshi?

RON FUJIYOSHI: My name is Ronald Susumo Fujiyoshi. I come here as a member of U.S. Japan Committee for Racial Justice. I also served as a missionary of the United Church of Christ for 29 years. Twenty of the years were in Asia. And after that, part of the time was in the pacific.

A friend of mine, Dr. Kosuki Koyama wrote a book called "Water Buffalo Theology," and one of the chapters of the book was called "Gun and Ointment." He said that western imperialism has gone and colonized the world, and in many cases the missionaries were the ointment that went along with the gun. And since I was a missionary, I wanted to state very clearly that we need to cut the ties of the missionaries, the ointment that goes with the gun, and to state very clearly that we oppose any gun.

So that's part of the reason why I am here today. I think the EIS or the Draft EIS that I read

is just a shibai. "Shibai" in Japanese is something like a show, just a show or a play or a deception. You know, all of the nice PR stuff that is written and says there's no impact, we know there's an impact because we know Marshallese people are dying of cancer. We know that the Department of Energy is cutting back the funds that are monitoring the Marshallese from the atolls of Rongelap and Utrik because of the expense and the war in Iraq.

These are the ones who were used as guinea pigs in the 67 nuclear and atomic tests. The cumulative effect of the 67 nuclear and atomic tests were 7,000 times the impact of the Hiroshima A bomb. You can't imagine what 7,000 times Hiroshima is.

Seiji talked about coming from Hiroshima, so he has seen firsthand the effect of just one A bomb on Hiroshima, and so it's beyond the scope of us to imagine what 7,000 times that would be.

I went to the Marshall Islands maybe about five times when I spent time there, and the last time I went was on March 1st of last year, which was the 50th anniversary of the Bravo test, and we were there with the survivors and heard their stories of that one Bravo test, which was the first U.S. hydrogen bomb tested. And so we heard the stories of what happened

in the tests. And to me it's very hard for the Marshallese people to believe the U.S. military, especially in cases like the EIS, because, as Elma explained, if you looked at the video called "Half Life," you would see that there was a U.S. Commodore Wyett who went and spoke to the Bikini Marshall Islanders after they came out of church on Sunday and he made a statement that you can see for yourself in here that they're going to harness this destructive nuclear force for the good of mankind, and he asked them, will you give permission to move off the island so we can do this for the sake of all mankind. And their response was something like, well, if it is the will of God, we will do it. And so he made the statement, and I can't forget his statement, well, if it is the will of God, it must be good.

You know, and that kind of a shibai or deception has gone down through the ages.

Many of you know that in 1972 Secretary of State Henry Kissinger confirmed U.S. thinking that American military interests must prevail over the self-determination of the Micronesian people when he casually remarked: "There are only 9,000 people there. Who gives a damn?" This was quoted by former Secretary of Interior Hickel.

So I think if you are Marshallese, are you going to believe an EIS statement that says no impact? I think it's very hard to convince them that there is.

I think those of us who are from Asian or Pacific background, we have a theology that all life is related. What is related is a harmony of life, so that what you do to one thing, affects everything else. But it's only a western kind of thinking that compartmentalizes everything and says, this spot will have no impact, this spot will have no impact, this spot will have no significant impact, this spot won't have, and then they go around the whole thing and say, therefore, there's no significant impact. Well, we know that's erroneous, because the whole understanding of how everything is interrelated is different from that. And I think we need to point that out to the people here.

We had JoAnn Wypijewski of the PST (phonetic) who was the managing editor of the Nation Magazine, went over to the Marshalls and did an in-depth story. And she went to Roi-Namur where some of the top U.S. military scientists are stationed. It's way in a secluded area and many of them are brilliant people because they are tracking the missiles. And they said that this is like a

bullet striking a bullet. It's impossible to do. It's impossible to do.

And so what they do actually is they put homing devices in the missiles so that they can have a chance of hitting the missiles. If they didn't have that, there would be no way they're going to do this. So here they're spending billions of dollars on Star Wars when the chances of success are so minute that it's wasting of money.

I think we should be using the money not to make war, but to build friends. And I think what it has to do with, places like the Marshall Islands, is to care for those who are affected by the 67 nuclear and atomic tests, and that's how you keep from having war. I think you build friends.

MR. BONNER: Could you finish up, Mr. Fujiyoshi, or come back?

RON FUJIYOSHI: Okay. I think what is happening is there's no transparency. So much of the things are done in secret that we don't know what is really going on.

I was arrested twice on Kauai, PMRF, when we tried to oppose the missiles being fired from Kauai to Kwajalein. Why? Because pacific people are now firing on Pacific people. And so it's being fired

from a burial site on Kauai. And one of the things we found out in one of the times we got arrested is that foreign, other countries, are using missiles to test their own missiles, too. And what do they use in the payload, that was secret. We couldn't find out what was it.

So all of the things that we're doing, we're trying to guess, because we don't know. They're asking us to believe them when there's no transparency. And we need to find out what is really going on.

For example, I read all of the material out there. I don't even see the word "depleted uranium." And depleted uranium is so crucial even right now, what is happening in Iraq or elsewhere, you know, people, even our own soldiers that went in Iraq in the first war, you know, were affected by that. I went to Vieques, and we know the effect of depleted uranium upon the people there.

So if they're not even mentioning depleted uranium in the material on here, then what else are they keeping from us? I think we have a hard time believing that what is being done is on good faith.

Finally, I think if it's true that the Missile Defense Agency refused to have public meetings

on Kauai where PMRF is and in the Marshall Islands, to me that's a very deep flaw. That's something that needs to be corrected. So I support stopping of Star Wars. Thank you.

(Applause.)

MR. BONNER: Thank you.

Terri Kekoolani?

TERRI KEKOOLANI: Aloha kakou. Kala mai ia'u. I'm going to turn my back to you folks. I want to talk to these guys.

I just want to make a few comments. First of all, the first comment I want to make has to do with the process. It is very deeply flawed. If what you are planning goes through, then obviously all islands will be impacted. Therefore, to properly inform our people here in Hawaii, you must have all people from all islands being fully informed, which would include the Big Island, Maui, Molokai, Lanai, Ni'ihau, and Kauai.

And it's amazing to me that you don't have a meeting scheduled in Kauai with almost half of an island impacted by the missile range facility there.

Also, just alone coming on Oahu, you're having a meeting in a very small hotel, in a small room. The capacity of the room is sixty people. And

so what it looks like is that you're kind of hiding, and that you are not looking for a way to actually get a lot of people to participate in this process.

So what you're doing is actually minimizing the input of people, but you sure are maximizing the hardware that's going into this plan of yours. So I think this is a very, very, big flaw.

Also I would like to say that I just returned from a visit on the island of Ka-ho'olawe and I mentioned to people who have been visiting from Kauai on the island that this hearing was taking place here on Oahu, and they didn't know about it. I don't know if you guys know how much it costs to get from Kauai to Oahu, but it takes some money, and our people don't have that kind of money. So it says something about you. It says something about how you folks think, that you don't have our people included in this process.

The second thing that I would like to talk about is five minutes. How long did it take you to put this study together? You all only give us five minutes to comment. I don't understand that.

The other thing is, that's not island style. It takes us maybe kind of like a couple of hours just to say hello, just to get to know you.

Like who are you, where you from, why are you here, what's on your mind, what do you want to do? What is going to happen with the plans that you are going to do to us? How is it going to impact us? That takes a long time. I mean, come on.

The other thing is, and people have already commented that you don't have any person here that can translate our language. And I'm glad Ms. Coleman spoke to you in Marshallese. You need to do your homework. Before you come to the islands, you should know what the people speak.

Then I just want to continue with just a few more comments. My name is Terri Kekoolani. I'm a member of Ohana Koa, a Nuclear Free and Independent Pacific. So on behalf of Ohana Koa I would like to say that we are absolutely against Star Wars, and that means that we would like to see the ending of all testing, development, and deployment of a Ballistic Missile Defense System.

Deployment of the Star Wars program threatens a new nuclear arms race, puts the global environment at risk, and undermines the security of the United States as well, and undermines the security of all people.

Also, Star Wars fuels the nuclear arms

race. Deployment will increase the likelihood of a nuclear catastrophe. BMDS greatly increases tensions between the world's nuclear powers.

On June 13th, 2002, George W. Bush unilaterally and without a vote of Congress withdrew the United States from the Anti-Ballistic Missile Treaty, once a cornerstone of arms control. We denounced that unilateral action.

Also, Ohana Koa believes that Star Wars will have a significant adverse impact on native Hawaiians, our Marshall Island brothers and sisters, the Enewetaks, and other indigenous peoples; and that the Programmatic Environmental Impact Statement fails to consider these impacts.

Hawaiian burials and sacred sites are desecrated by the missile launches and Star Wars facilities, while cultural practices and subsistence access rights are denied due to base security measures.

That is already taking place right now on Kauai. You folks have missile launching pads over there on top of an ancient burial ground. It's called Nohili. It is a crime. It's a crime.

And also there are now people being denied access to beachfronts that have traditionally always

been accessible by our people.

So, anyway, on behalf of Ohana Koa, a Nuclear Free and Independent Pacific, we are totally against the Star Wars and want to make that very clear. Mahalo.

(Applause.)

MR. BONNER: Thank you.

Marion Ano.

MARION ANO: Aloha kakou everybody. My name is Marion Ano and I say no to Star Wars. I'm representing my kupuna, my fellow kanaka, keiki o ka 'aina.

You know, when our kupuna arrived here, there was peace, there was always enough water, food and 'aina, land. My personal EIS is Hawaii, and the world is simple. Malama 'aina, malama ai kupuna, malama our fellow men, women, children, and all living organisms.

I'm a being of peace and build world peace through nonviolent ways and aloha. Mahalo.

(Applause.)

MR. BONNER: Thank you.

Kanoa Nelson?

KANOA NELSON: (*Speaking in Hawaiian - Eie no… E hele mai ʻo Kanaloa ʻoli /This is a chant in which places and gods are named including Kanaloa, the god of the seas*).

I'm a practitioner of native Hawaiian

crafts and tradition. And I believe Hawaii is the center for Ho'oponopono (*fixing and making right*), for healing, for healing the people not only that live here, but the center for gathering of the world as people come to visit here. They learn aloha spirit. And something that we still have to teach people is kuleana (*right and responsibility*), and kuleana is that we are deeply connected to this 'aina. Our genealogy goes back to Papa and Waikea, earth mother and sky father. And every Hawaiian's genealogy goes back to that. And we have a deeply rooted sense of connection to whatever happens to the 'aina (*land*). We feel it inside of our body when the earth is damaged. So there's something that we will feel, the 'eha (*pain*) of this 'aina as it's damaged. No matter where it is, even on Kauai, we on Oahu, I will feel that inside of me. So I want everybody to remember us Hawaiians as deeply connected. Aloha.

(Applause.)

MR. BONNER: Thank you.

Corrine Goldstick.

CORRINE GOLDSTICK: I am against the Star Wars. I'm Corrine Goldstick. I'm affiliated with American Friends Service Committee. Since I've been here tonight, I've been thinking, well, I know you people can't do anything about stopping this, and so I

started thinking about the politics of it and the law of this whole thing being dumped in our laps, and it seems to me that there could be a point made, maybe by a good attorney, that it's illegal to begin with, because Bush in cancelling our participation in the Missile Treaty acted illegally. Of course, he was not stopped by our Senate as should have happened. Bush then instructed his Department of Defense Secretary Donald Rumsfeld to proceed with this program, if you can call it that, and the steps have been taken to start.

And I just wanted to maybe ask, although you probably don't want to speak: What if a new administration comes in in November and a better Congress, certainly a better Senate that would proceed to challenge him, challenge Bush and Rumsfeld and the pentagon, you know, where would this leave Star Wars? I hope it would leave it in the mud. Thank you.

(Applause.)

MR. BONNER: Thank you.

Keli'i Collier?

KELI'I COLLIER: (*Speaking in Hawaiian - He kanaka maoli wau. ʻO kena koʻu a ../inaudible/ Hewa ke kaua ʻAmelika. Makemake wau e haʻalele i ka pae ʻaina o Hawaiʻi. /I am a native Hawaiian. That I have … The American war [star wars] is wrong. I wish for it to leave the Hawaiian islands*).

My first point, I want to address the process. And I'm not sure what his name was, but

you're talking about written, e-mail submission of comments, right?

Native Hawaiians rank amongst the largest statistics for disease, social issues, drug abuse, domestic violence, and whatnot. How many Hawaiians do you think on Kauai or Maui, Hawaii island, Molokai, Ni'ihau, Ka-ho'olawe have access to internet? Take a guess.

MR. DUKE: I really don't know.

KELI'I COLLIER: Okay. Not much. So when you say that you weigh the written testimony as heavy as the oral testimony, that premise alone is a fault of yours, it's a fault of your thinking, it's a fault of your understanding of where you are, this context of Hawaii.

These people can barely feed themselves half the time. They can barely send their kids to school with slippers. So that's something you got to wake up to fast.

My second point is, this, what is it, BMDS, it's just another component of America's imperialistic forces going around the world and taking land and natural resources and basically slave labor to extract natural resources to gain military strategy over other countries so they can go in and take their

natural resources; aka oil, right?

We've been colonized, land, ocean, water, and now you want to take the skies and the heavens. I can't fathom how you guys can sit here and think that this thing is going to be beneficial, because it's not.

As far as the environmental impacts, I was reading some of your poster boards. Spilled fuel, soil disturbance, and whatnot, no impact.

When you go hiking and you walk on a trail, there's an impact from my 220 pound body. What is a missile going to do when it's blasting off from the ground going up into space and trying to intercept each other and they miss and go and they land someplace else? Is that in your impact statement?

What if I went to John Muir Redwood Forest and decided to build a spam fast-food restaurant, drive-through, and I did an EIS for all the cars that would be coming through the redwood forest and go, you know what, no impact. Cutting down the trees, these thousand-year-old trees, no impact.

My final point is the cultural impact. As Auntie Terri said earlier about Nohili, it's a graveyard, how about if I took my spam fast-food restaurant and franchised it and put it in Arlington

Cemetery? How would you feel then? And I start digging up bones and you guys tell me there's bones, and I say, oh, yeah, yeah, take your bones, I got to build my restaurant here.

(Applause.)

MR. BONNER: Thank you.

Would anybody else like to come up and make a comment?

Go ahead.

EMMA GLOVER: I'm Emma Glover. Fear is the most destabilizing force in the world, whether we're talking about fear between individuals or fear between countries. It can result in actions which in the long term are seen as very regrettable and very ill-advised.

This whole program assumes fear. I suggest, in addition to the alternative number 4 that's already been suggested, an alternative number 5, which came to me as I was reading your information.

This BMDS assumes that there are potentially threatening areas in the world. I would suggest employing (inaudible) and analysis, and many of the same scientists could do this that have been working already on this, so they wouldn't lose their jobs. They can analyze the problems which are

currently being encountered by residents of the areas of the world that are viewed as potentially threatening.

They could figure out what are the fears in the people that live there. Are they afraid of starving to death? Are they afraid of catching a disease from polluted water? Is the soil not sufficiently productive because it lacks certain nutrients? Is there lack of education on how to build a sustainable future for them and their children and their children?

If we spend the same amount of money doing some of this analysis as a fifth alternative, I have a hunch that we won't even need any ballistic missiles.

(Applause.)

MR. BONNER: Thank you.

Danny Li?

DANNY LI: Good evening. My name is Danny Li. Good evening. I'm with Nadi Nao-ying (phonetic), a group that's opposed to the people who commit violence on the world.

The best behavior, best predictor of future behavior of anyone is the history of past behavior. I think ever since the advent of the missile age, if I can recall, I could be wrong, some

sixty years ago, I don't think there was ever a missile or rocket that has been fired against the United States. Not a single one.

In that same period there have been lots of missiles and rockets fired all over the world, every continent, by armed forces of the United States. And I'm not even talking about now. In every single continent.

So there is an example of, you know, what words mean, and yet these are all done under the name of Department of Defense.

It's more properly called Department of Offense if you look at the history. So that's part of the problem.

(Applause.)

So just as you do not trust, you do not trust a convicted serial rapist to run a child safety program, you cannot ask the same kind of people to run a so-called missile defense. So get rid of it. We're opposed to it. The people of the world are getting wise to that, and they're all opposed to this. Mahalo.

(Applause.)

MR. BONNER: Ikaika Hussey.

IKAIKA HUSSEY: Aloha kakou.

(*Speaking in Hawaiian - Aloha kakou. ʻO wau ʻo Ikaika Hussey. No ka ʻaina o kaʻewu au. ʻO koʻu ʻōhana no Kohala, Hawaiʻi makou. Honokohau. Mai ka mua loa, mai ka wa kahiko mai a i keia la. He Hawaiʻi, he ʻōhana Hawaiʻi koʻu ma ka ʻaina o Kauaʻi. A ma laila no, ma laila no hoʻi ka makemake, ka ʻiʻini o ʻAmelika no hoʻi ma ko lakou ʻaina no laia (unintelligible) Polihale. No laila, eia wau no ke kuʻe, e kuʻewa, e kupaʻa no hoʻi, i keia ke kaua aʻo kou halawai.*
/Greetings to all. I am Ikaika Hussey. My family is from Kohala, Hawaiʻi. Honokohau (?). From the past, from ancient times until today. Hawaiian. I have Hawaiian family on the land of Kauaʻi. It is there, there indeed, where America wishes and desires their land, thus /unintelligible/ at Polihale. Therefore I am here to oppose and resist firmly this war [star wars] at your meeting.)

In addition to my own opposition to the proposed ballistic defense system, I come here with words from people who were not offered the opportunity to testify this evening because there was no hearing on the island where they reside and where the impacts will take place.

I'd like to begin with offering the testimony of Mr. Jumble (phonetic) Kalaniole Fu who is a fisherman, commercial fisherman, in a family-owned business on the island of Kauai. He experiences on a regular basis the militarization of his island. He witnesses the missiles leaving Pole Hale. He witnesses the missiles flying up out of the ocean.

He is told that he can't fish in certain areas because of military work that's being done.

He's also very concerned because he's seen it for so long. He talks about 18 years of the people of Kauai constantly being told and being exposed to the Star Wars program to the point where they have

become desensitized to it.

He's concerned about the effects that it has on his family. He's spoken to me about the fact that there is no research being conducted to ascertain health effects on the people of Kauai, about the

propellants and all those things.

He is also very concerned simply because of the very dangerous things that we're talking about here. We're talking about missiles. A missile has no function but to be a weapon, unless you put a person into it and they're going to explore outer space. Even in that case there's a probability that there's imperial notions at hand. But what we're talking about here are very dangerous things, and he is concerned about the possible dangers that might come upon him and his family and his people on Kauai.

He has seen missiles that misfired or missed their target and destroyed or -- apparently a missile hit another boat, another American vessel. And he doesn't want to see that happen either to the American military or to his own family. So that was his concern.

I also would like to relate the testimony of Mr. Wilfred who e-mailed me from Canada, and obviously there's no hearing in Canada, but he is very concerned because he knows that the proposed American military expansion, the full-spectrum dominance that we're talking about here, he is concerned about the effects that will have on him and his people in Canada.

He is concerned that it will spark a new arms race. He also mentioned to me that 70 percent of the people in Canada, of people polled in Canada, opposed the Ballistic Missile Defense System, so if that's an indication.

Since 1893, and actually before then, America and the greed of America and also the greed of other European countries, we've experienced that greed through military incursion consistently. American businessmen, European businessmen who wanted to set up shop in Hawaii and sell sandalwood and do whaling, and sell sugar and pineapples, the way that they were able to fulfill their avarice was by calling on the military of their countries to come and support them in their desire for Hawaiian land.

All the way through 1848 to the Mahele and then past the Mahele to 1893 we've had constant military invasions from the outside, people wanting our land for their purposes.

Since 1893 American military has only procreated in Hawaii. It's ironic, I know. And the guns that were pointed at the palace have multiplied, and now we're talking about missiles. And I can't bear the thought of my family and my family's land being part of anyone's desire for empire.

I have no desire for empire personally. I have no desire for dominating anyone. So I can't even fathom the idea of full-spectrum dominance. It seems absolutely inhumane, and I don't think that it is something that you folks or the people of America, people of the United States of America have innate to them. I don't believe that there's something that's genetic about Americans that says that they will try to promulgate empire. So I can only hope for the emergence of humanity in the United States, and the toppling of a regime that will only promote dominance of other peoples.

(Applause.)

Finally, I would like also to present the testimony of 1,330 people who signed petitions opposing the expansion of military in Hawaii. And these people need to be included in the process. They need to be notified of the Record of Decision. Thank you.

(Applause.)

(Document tendered.)

MR. BONNER: Thank you.

Jacina Fernandez. Is she still here?

Fred Dodge?

DR. FRED DODGE: Aloha kakou.

AUDIENCE: Aloha.

DR. FRED DODGE: My name is Fred Dodge and I'm a physician, a family practitioner. I'm happy to see two other family practitioners testifying today. We take seriously our role in trying to use preventive medicine in treating communities. I'm also a member of PSR, Physicians for Social Responsibility, and IPPNW stands for International Physicians for the Prevention of Nuclear War, and I also am a member of other organizations. I'm not here representing any of them officially. I speak for myself.

I want to add my voice to those who said that the process is flawed. You really need to hold hearings on Kauai, other places also, but especially Kauai where the Pacific Missile Range Facility is located, who are really greatly impacted by this. And I, too, have friends on Kauai who didn't know about it and want the opportunity to testify.

The Ballistic Missile Defense System, let's just call it Star Wars, everybody seems to know it by Star Wars, is really a part of our warfare state. A lot of people criticize the welfare state mentality, but we really have more of a warfare state mentality now more than ever.

(Applause.)

I think to those who have examined this whole system, it really has -- I mean, it's put forth as a defensive system, but it really has a great deal of offensive capabilities, and is certainly seen that way by other nuclear powers, especially Russia and China.

I believe it to be dangerous to humans and other living things, and, therefore, I'm certainly against it.

I also question the conclusions of the PEIS in that alternatives that have been mentioned in the past aren't included. I won't go into that except I support those. The lack of detail on cumulative effects is a major defect. And I think the lack of environmental and racial justice needs to be addressed more fully certainly.

And after saying all this, believing it, I agree with Ron Fujiyoshi that it's shibai, this whole thing is something you just sort of go through, because it's going to get approved. But yet we must speak out.

Ghandi has said you have to speak truth to power, and certainly you guys have the power or you represent the government with the power, but we must speak out.

It seems to me that instead of threats from missiles, there's a lot more threats from the suitcase A bombs the U.S. had and then Russia developed the backpack. These are portable A bombs. The horrific thing about it is that the sources that I have read and listened to and so on say that a lot of these are not accounted for in Russia during the changeover, they're missing. Where are they? I mean, they're the things that can be brought into the U.S.

I don't know how many people are aware of the fact that about a month after 9/11 the U.S. received reports that one of these portable A bombs was somewhere in New York City.

Fortunately it turned out that this was not an accurate report, like many of our intelligence, it was not correct, but it's interesting to note that Mayor Guilliano was not notified of this at the time and was extremely angry when he found out that this had happened. And apparently there was no way, if that were to happen, to find it. That's a real threat, much more so.

The other thing that I want to mention is that all the information that I've read, mostly from independent scientists, says that the Star Wars project is very likely to fail. Originally the PSR,

the Physicians for Social Responsibility, had taken up on that there was - originally they said there would be six percent chance that a missile could get through, especially the multiple warhead type, and so they gave every member of Congress an umbrella with holes in the umbrella amounting to 6 percent of the umbrella surface. It won't keep you dry.

It's also extremely wasteful, and I think that's been addressed here today. It's bound to escalate the arms race.

I had a letter from the late Patsy Mink, representative from Hawaii, and I'll quote what she told me at the time. This is already three years ago. But she said: The National Missile Defense System has the potential to destabilize our relationship with other nuclear powers and will violate the Anti-Ballistic Missile Treaty, which was then in effect. And, as people have stated, our present president has withdrawn us. And certainly we question whether that withdrawal by the president, without congressional support, is legal.

She goes on to say: We should not deploy a system if we don't know whether it will work, which violates our treaty obligations and escalates deployment of nuclear weapons by potential

adversaries. In other words, they see it as offense and they're going to be building up. And other people have stated the same thing.

So where are we at? In my opinion, we don't need it. The world certainly doesn't need it. The project should be abandoned. We could save billions. We could even use it for some human needs, such as 45 million people who don't have health insurance in the United States, for instance. This is where I come from.

I also was going to quote President Eisenhower, but that's been so eloquently quoted earlier.

I'll just say that if there's any way possible to do some of those other alternatives, at least put this on hold, if not scrap it, I think that would be the way to go. Thank you very much.

(Applause.)

MR. BONNER: Thank you.

Let me make a last call for anyone else who would like to make comments.

KAREN MURRAY: Hi. My name is Karen Murray, M-u-r-r-a-y.

MR. BONNER: Thank you.

KAREN MURRAY: I was born here in 1955, four

years before this was declared a state. I wasn't born a citizen, as most people here were not. A lot of the statehood and a lot of the things that declare us citizens, we understand that it's an illusion. The wrong questions were asked, people were not invited to be citizens that were declared citizens. There are so many layers of illusion that, in Hawaii, you can see very clearly, because it's a small microcosm.

When they talk about Saddam Hussein ignoring U.N. resolutions and international requests, here in Hawaii we look around and we see that the United States has done this to such a greater degree. We know that in the Hague we were recognized, the Kingdom, the Nation State of Hawaii was recognized, and the illegality of the United States in Hawaii was recognized.

We had the Apology Bill, we had all kinds of things that lift the veils from our eyes, that make it so that we can see through the illusions.

So when we look at Star Wars and we look at the effects on Kauai - my mother is from Kauai, her family is on Kauai - when we look and we're told and we look around and we look at where this hearing is held and how it's held, we know that Star Wars is just another illusion, because it's just another part

of the play that has George Bush under a banner saying mission accomplished. It's another part of the play that says we have something to fear and so you need us to protect you.

Everywhere I've traveled I've met beautiful, wonderful people. I've been warned people are, people in New York even, I've been warned against people in almost every part of this country, but everywhere I went there were beautiful people, and I imagine that so everywhere in the world.

We can live from fear or we can use fear as an advisor and live from beauty and truth, and what the earth really is. We can lift the veils from our eyes and see what the world really is.

And your participation - I came up here because I want you to understand your participation in enforcing this illusion that we need Star Wars, that some of the world needs Star Wars, that the world needs more propagation of the idea of fearing each other, more than being cooperative and friendly and living together.

When you have Nobel prize winning scientists getting up and saying we have to turn this planet around, we have to turn our idea about how to run this planet around or else the environmental

impacts will be irreparable, that was said, what, fifteen, sixteen years ago? And they gave it about twenty years.

We don't have very long. We don't have very long for people in your positions to wake up and turn us around so that we can all survive on the earth together. And that's what we need from you. Thank you.

(Applause.)

MR. BONNER: Thank you.

Anyone else?

SEBASTIAN BLANCO: Hello. My name is Sebastian Blanco and I wasn't sure if I was going to say anything tonight, but I've been watching the three of you and I've been feeling a little bad for you. No one all night long has spoken in favor of Star Wars, so I thought I would do that. I thought I would come here and talk about what Star Wars is. It just came out on DVD, great movies.

And the message of those movies is that no matter how evil you are, even if you are Darth Vader and control the Death Star, control the empire, you can do good. You can turn on the emperor in the end and throw him down the shaft of the Death Star.

(Applause.)

And you guys are going to go home tonight or later, and you have a choice to make. You've heard from the rebellion tonight. There's things you can do to help stop this program. It doesn't help people. It kills people. It kills things. It is evil.

We are doing what we can do tonight, but Luke couldn't do what he needed to do on his own. He needed Darth Vader to turn around. And that's kind of, I think, one of the messages that we have for you tonight. As individuals, you can make decisions to speak out against this thing, to make it less wrong.

So that's why I am speaking in favor of Star Wars, but not your Star Wars. Thank you.

(Applause.)

MR. BONNER: Thank you. Marty, final comment?

MR. DUKE: Well, thanks for the comments there. Liven it up a bit.

Again I want to thank each and every one of you for coming out. We were here as part of the NEPA process, and that process is to hear from the public and to get your comments and to go back and analyze those comments.

And, as you know, frankly, some of the comments are political and maybe outside the NEPA process. It's an opportunity that you can make your

comments, and we recorded those, and we'll go back and analyze those. And comments that, you know, we need more public forums to hear about the NEPA process and what our Programmatic EIS is, we'll take those comments back and we'll analyze those and discuss those with our leadership and determine what to do.

Again, I appreciate you coming out and I respect all your comments, all your views, and thank you again.

(Hearing adjourned at 9:11 p.m.)

STATE OF HAWAII)
) ss.
CITY AND COUNTY OF HONOLULU)

I, Julie A. Peterson, Notary Public, State of Hawaii, do hereby certify:

That on October 26, 2004, commencing at 6:34 p.m., the above PUBLIC HEARING was taken in machine shorthand by me and thereafter reduced to typewriting under my supervision; that the foregoing represents, to the best of my ability, a true and correct transcript of the proceedings had in the foregoing matter.

I further certify that I am in no way interested in the aforementioned proceedings.

Dated at Honolulu, Hawaii, this ______ day of November, 2003.

____
NOTARY PUBLIC, STATE OF HAWAII

My Commission Expires:
September 1, 2006

APPENDIX C
RELATED DOCUMENTATION

RELATED DOCUMENTATION

The documentation identified below has been incorporated by reference in the BMDS PEIS. The information and analyses contained in these documents were used in the development of this PEIS and have been summarized as appropriate. These environmental assessments (EAs) and environmental impact statements (EISs) have previously been prepared to support the development of the specific technologies that may be used as part of the BMDS and the locations where these technologies may be used.

- Ballistic Missile Defense Organization, Space and Missile Systems Center, 2001. *Space-Based Laser Integrated Flight Experiment Ground Testing Environmental Assessment,* January.

- Ballistic Missile Defense Organization, 2000. *Ballistic Missile Defense Organization Cooperative-Engagement-Capability/PATRIOT (CEC/PATRIOT) Interoperability Test Environmental Assessment,* July.

- Ballistic Missile Defense Organization, 1998. *Air Drop Target System Program Programmatic Environmental Assessment,* May.

- Cortez III Environmental, 1996. *Lance Missile Target Environmental Assessment.*

- Federal Aviation Administration, 1996. *Environmental Assessment of the Kodiak Launch Complex, Kodiak Island, Alaska,* June.

- Missile Defense Agency (MDA), 2003. *Ground-Based Midcourse Defense Initial Defensive Operations Capability at Vandenberg AFB Environmental Assessment,* July.

- MDA, 2003. *Airborne Laser Program Supplemental Environmental Impact Statement,* June.

- Strategic Defense Initiative Organization, 1992. *Midcourse Space Experiment Environmental Assessment,* September.

- U.S. Army Space and Missile Defense Command, 2003. *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement,* July.

- U.S. Army Space and Missile Defense Command, 2002. *Theater High Altitude Air Defense Pacific Test Flights Environmental Assessment,* 20 December.

- U.S. Army Space and Missile Defense Command, 2002. *White Sands Missile Range, New Mexico, Liquid Propellant Targets Environmental Assessment,* 23 May.

- U.S. Army Space and Missile Defense Command, 2002. *Ground-Based Midcourse Defense Validation of Operational Concept Environmental Assessment,* 15 March.

- U.S. Army Space and Missile Defense Command, 2000. *National Missile Defense Deployment Environmental Impact Statement,* July.

- U.S. Army Space and Strategic Defense Command, 1998. *Theater Missile Defense Extended Test Range Supplemental Environmental Impact Statement,* June.

- U.S. Army Space and Strategic Defense Command, 1998. *Tactical High Energy Laser Advanced Concept Technology Demonstration Environmental Assessment,* 17 April.

- U.S. Army Space and Strategic Defense Command, 1995. *U.S. Army Kwajalein Atoll Temporary Extended Test Range Environmental Assessment,* 19 October.

- U.S. Army Space and Strategic Defense Command, 1994. *Theater Missile Defense Extended Test Range Environmental Impact Statement,* November.

- U.S. Army Space and Strategic Defense Command, 1994. *Theater Missile Defense Ground Based Radar Testing Program at Fort Devens, Massachusetts Environmental Assessment,* 22 June.

- U.S. Army Space and Strategic Defense Command, 1994. *Theater High Altitude Area Defense Initial Development Program Environmental Assessment*, March.

- U.S. Army Space and Strategic Defense Command, 1993. *Theater Missile Defense Programmatic Life Cycle Environmental Impact Statement,* September.

- U.S. Army Space and Strategic Defense Command, 1993. *Ground Based Radar Family of Strategic and Theater Radars Environmental Assessment*, June.

- U.S. Army White Sands Missile Range, 1998. *White Sands Missile Range, Range-wide Environmental Impact Statement,* January.

- U.S. Department of the Air Force, 2002. *Early Warning Radar Service Life Extension Program, Cape Cod Air Force Station Environmental Assessment, Massachusetts,* September.

- U.S. Department of the Air Force, 2000. *Evolved Expendable Launch Vehicle Program Supplemental Environmental Impact Statement,* March.

- U.S. Department of the Air Force, 1998. *Evolved Expendable Launch Vehicle Program Environmental Impact Statement,* April.

- U.S. Department of the Air Force, 1997. *U.S. Air Force atmospheric interceptor technology Program Environmental Assessment,* November.

- U.S. Department of the Air Force, 1997. *Environmental Impact Statement for the Program Definition and Risk Reduction Phase of the Airborne Laser Program,* April.

- U.S. Department of the Air Force, 1990. *Starlab Program Environmental Assessment,* 17 August.

- U.S. Department of the Navy, 2002. *Point Mugu Environmental Impact Statement/Overseas Environmental Impact Statement,* March.

- U.S. Army Space and Missile Defense Command, 2003. *Arrow System Improvement Program Draft Final Environmental Assessment,* August.

- U.S. Department of the Navy, 1998. *Pacific Missile Range Facility Enhanced Capability Environmental Impact Statement,* December.

APPENDIX D
DESCRIPTIONS OF PROPOSED BMDS ELEMENTS

DESCRIPTIONS OF PROPOSED BMDS ELEMENTS

D.1 Airborne Laser

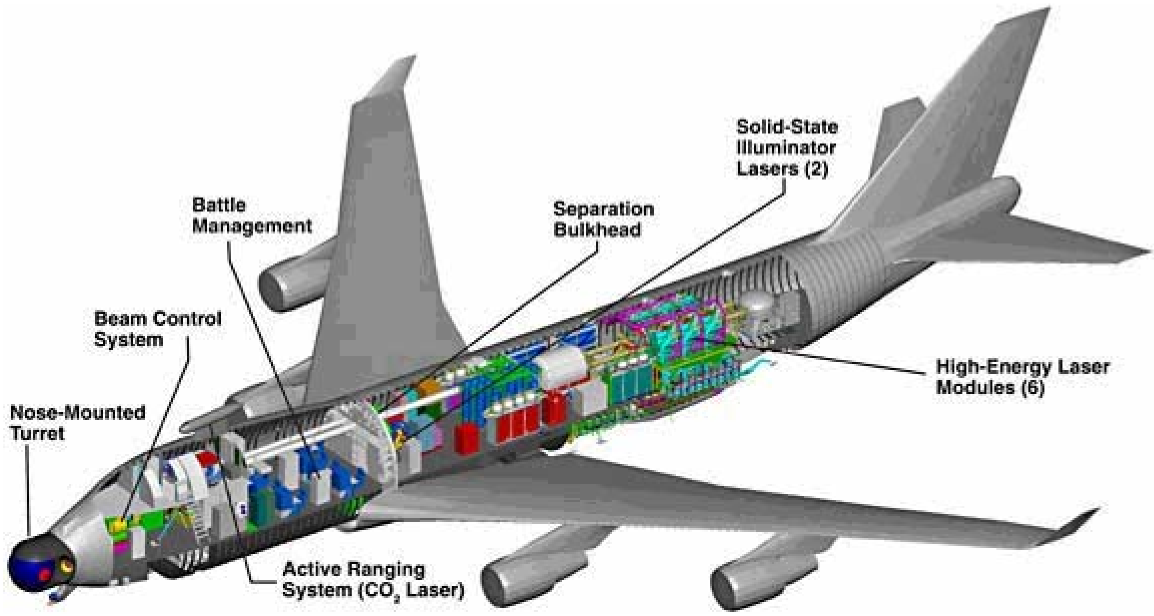
Introduction

The Airborne Laser (ABL) is a part of the Boost Phase Defense Segment of the BMDS. The ABL is a rapidly deployable airborne platform equipped with a long-range laser weapon capable of acquiring, tracking, and negating threat ballistic missiles in the boost phase of their flight (i.e., powered flight, prior to booster burn-out). ABL is designed to operate autonomously as well as in concert with other BMDS elements.

The ABL aircraft is a Boeing 747-400F modified to accommodate the laser weapon system, laser fuel storage tanks, onboard sensors, battle management command, control, communications, computers, and intelligence (BMC4I), and a beam control/fire control (BC/FC) system (see Exhibit D-1). The ABL aircraft would fly at altitudes above 10,668 meters (35,000 feet) and would detect and track launches of enemy ballistic missiles using its onboard sensors. Directed energy from the laser weapon would heat the threat missile body canister. Ground support assets of the ABL element include chemical storage, mixing, and handling facilities; chemical transport and loading/unloading; optics handling and maintenance; and aircraft support and maintenance facilities.

The ABL consists of several coordinated sensor and laser systems. The BMC4I infrared search and track (IRST) and Active Ranging System (ARS) suite would detect and track the target ballistic missiles. The ARS laser is a lower-power carbon dioxide (CO_2) laser that would acquire and assess the range to the target. The Track Illuminator Laser (TILL) is a lower power, solid-state laser. Designed to track the intended target, reflected light from the TILL returned to sensors onboard the ABL aircraft provides information about the target's speed, elevation, and vector. The Beacon Illuminator Laser (BILL) is a lower-power, solid-state laser that serves as part of a laser-beam control system designed to focus the laser weapon beam on the target and to correct for any atmospheric distortion. All of the ABL lasers firing off of the aircraft are American National Standard Institute (ANSI) Classification 4 lasers. The Surrogate High Energy Laser (SHEL) is tens of watts, the ARS hundreds of watts, the BILL and TILL are KW class, and the High Energy Laser (HEL) is MW class. Only the HEL, a Chemical Oxygen Iodine Laser (COIL), is designed to destroy the target missile.

Exhibit D-1. Airborne Laser



During operations, the ABL BMC4I system would prioritize IRSTand ARS track files and nominate targets, forwarding this information to both the BC/FC system and the communications suite, which maintains inter-theater connectivity with other BMDS elements. BC/FC would then establish precision tracking, stabilized pointing, and atmospheric compensation. After BC/FC has determined an accurate track on the nose of the missile, selected an aim point, and determined the atmospheric compensation required to propagate a laser with high beam quality to the target, a fire command would be passed to the laser segment. The laser beam would be directed through a beam tube to the forward optical bench, where it would be controlled, compensated, and focused through a nose-mounted turret to the boosting missile target. The ABL then would identify and report target negation.

ABL would be integrated into the BMDS battle management architecture. Using its surveillance sensors, ABL would provide highly accurate ballistic missile launch point, impact zone, and state vector data to the BMDS via a near real-time data exchange network (i.e., Tactical Digital Information Link network). The network would provide the ABL connectivity to other BMDS elements and airborne assets such as the Airborne Warning and Control System and Joint Surveillance and Target Attack Radar System. Once intelligence and other off-board track data are received by the ABL, the battle management system would correlate the data with onboard sensor data and databases to provide the crew with the best information. This information would maintain the rapid-reaction situation awareness required to execute the boost phase intercept mission in the most effective manner. The information on friendly and enemy assets would also provide necessary information to prevent ABL from shooting down friendly missiles or aircraft

and to enhance self-defense. The ABL has an Identification Friend or Foe transponder capability that identifies ABL when interrogated by friendly assets.

Development

The U.S. Air Force (USAF) began to develop the concept of aerial battleships armed with one or more high-power lasers that could be used to blast enemy aircraft or ground-to-air missiles in the 1970s. Initially a KC-135A was chosen to be the platform for a CO_2 gas dynamic laser. Christened the ABL Laboratory, the specially modified aircraft shot down its first target – a towed drone – over the White Sands Missile Range (WSMR) in New Mexico on May 2, 1981. The event marked the first time a high-energy laser beam had ever been fired from an airborne aircraft. On July 26, 1983, the Air Force announced that the ABL Laboratory had been used to shoot down five Sidewinder air-to-air missiles.

In 1992, following the Persian Gulf War, interest was revived in developing laser weapons systems to counter ballistic missiles. In 1993, the USAF began development of ABL as part of Strategic Defense Initiative (SDI) since one of SDI's goals was to study ways that directed energy could be used in a weapons system. On November 12, 1996, the USAF awarded a $1.1 billion contract to three defense contractors to begin working on a prototype ABL that would detect, track, and destroy theater ballistic missiles during their boost phase.

Present development efforts are focused on completing the first ABL aircraft at Edwards Air Force Base (AFB), California. The Boeing 747 aircraft was purchased and flown to Wichita, Kansas where the nose was removed and several modifications were made, including attaching a mock turret. The aircraft was then flown to Edwards AFB for integration of the weapon components, sensors, BMC4I, and BC/FC.

Also located at Edwards AFB is the Systems Integration Laboratory (SIL). The SIL contains a Boeing 747 body that is being used to test the integration of the various ABL components prior to placing them in the actual first ABL aircraft. The development of the first ABL would involve completion of ground testing of ABL components including a flight worthy, six module, weapon class laser and ground and flight testing of the BC/FC system. It would focus integration and ground testing of the laser, BC/FC, and battle management. This effort would culminate in a shoot down of a threat missile target not earlier than 2008.

Follow on efforts would continue to perform ground and flight tests of the first ABL weapons system. Program emphasis would be on continuing ABL-specific technology maturation for integration and testing on subsequent blocks. Technology maturation includes improvements in domestic capabilities to produce advanced optics for high-energy laser systems. Ground support enhancements would focus on redesigning the laser fluid management system for air transportability and rapid deployment to enable the

ABL to move to and operate from a forward operating location. Specific locations for these potential forward operating locations have not been determined.

Future efforts would include maturation and development of a second ABL aircraft to include new technologies, enhanced lethality, and additional operational suitability. The second aircraft would be similar to the first aircraft (i.e., a Boeing 747-400 outfitted with COIL technology and tracking and ranging lasers) but would be further optimized to obtain increased performance. New laser module designs and advances in optics and control systems would be tested in the SIL then integrated onto future aircraft. The second aircraft would support the BMDS test bed and potential ABL production decisions. The USAF is planning an operational fleet of ABL aircraft to conduct dual-orbit operations in a major regional conflict. Details of the development schedule and full operations for the ABL Program are under development.

Testing - First ABL

The ABL test program is intended to build on the technology and risk reduction accomplishments of testing activities to date. The testing would initially focus on testing and verifying independent components of the ABL system. The individual components would then be integrated and tested in the SIL and then on the aircraft, leading up to a lethal shoot down. This testing involves both ground and flight-testing. Extensive ground testing includes segment level testing at a variety of contractor and government facilities and system level testing of the lower-power laser systems (i.e., ARS, BILL, TILL, and a SHEL) at Edwards AFB. The SHEL is a lower-power laser designed to simulate the operating characteristics and wavelength of the HEL during testing activities.

Flight-testing consists of airworthiness testing of the ABL aircraft itself as well as testing of individual segments after they are integrated into the weapon system and after laser testing in the SIL. Test flights at WSMR, Edwards AFB, and Vandenberg AFB would be used to test the lower-power lasers and the HEL. The tests would include acquisition and tracking of missiles as well as high-energy tests. The tests would be conducted against instrumented, diagnostic target boards carried by missiles or aircraft, including the Missile Alternative Range Target Instrument (MARTI); the Lance, Black Brant IX, Hera, and/or Two-Stage Terrier missiles, and the Proteus Aircraft (i.e., manned aircraft with target board attached). Flight-testing would culminate with the shoot down of a ballistic missile target. The specific testing areas currently planned include

- **BC/FC Ground Test.** This test would be conducted at contractor facilities in Sunnyvale, California and would involve positioning the turret in the correct relationship to the illuminator bench of the laser weapon component to ensure proper alignment. Testing would also demonstrate the TILL and BILL operation through the

BC/FC system. The objective is to demonstrate the performance of the beam-control segment at low power.

- **SIL Laser Ground Tests.** This test would be conducted at Edwards AFB and would involve a step-by-step buildup of laser operation. The objective is to verify successful integration of all HEL modules in the SIL. The major milestones for the SIL ground tests include chemical flow, first light, and full duration lase.

- **Integration of the BC/FC with BMC4I.** This test would demonstrate the ability to operate the BC/FC on the aircraft in preparation for flight tests.

- **System Demonstration.** This test would involve the shoot down of a threat representative ballistic missile target. The test missile would be launched from Vandenberg AFB with engagement and negation occurring over the Western Range. Up to three target missiles could be used, with the goal of one successful negation.

Ground-testing activities of the lower-power laser systems (i.e., ARS, BILL, TILL, and SHEL) would be conducted from an aircraft parking pad or the end of a runway at Edwards AFB, with the laser beam directed over open land toward ground targets with natural features (e.g., mountains, hills, buttes) or earthen berms as a backstop. The ARS would also be tested using a ground-based simulator within Building 151 at Edwards AFB. Ground testing of the HEL would be conducted at Edwards AFB, within Building 151 or in the SIL, using a ground-based simulator or an enclosed test cell. No open-range testing of the HEL would be conducted at Edwards AFB. These activities would involve testing the laser components (first and second ABL configurations and upgrades of new technologies) on the ground in the SIL and after they are integrated into the first aircraft. The ground tests would be conducted to verify that the laser components operate together safely in a simulated flight environment. Photons from the tests may be utilized in an enclosed test cell to evaluate the effect of the HEL on various target-representative materials. Up to 500 rotoplane (Ferris wheel-like rotating target) and 500 ground target board tests would be conducted for the first aircraft. Similar tests would be conducted for the follow-on aircraft. The HEL weapon system would be connected to a Ground Pressure Recovery Assembly to test the laser on the ground. On the ground, the Ground Pressure Recovery Assembly would simulate the atmospheric pressure that occurs naturally when the laser device is operating in the aircraft at altitudes of 10,388 meters (35,000 feet) or higher.

Flight-testing activities would occur at WSMR, Edwards AFB, and Vandenberg AFB to test the ARS, BILL, TILL, and SHEL, and the high-power HEL. Up to 15 MARTI Drop tests would be conducted at each of Vandenberg AFB and WSMR to test the ARS, BILL, TILL, and SHEL. Half of the MARTI tests at each location would also incorporate testing of the HEL. Up to 50 Proteus Aircraft tests would be conducted at each of Edwards AFB, Vandenberg AFB, and WSMR. The Proteus tests would involve only

testing the ARS, BILL, TILL, and SHEL systems. Flights may also include onboard beam dumps to internally check the HEL firing, as well as diagnostic checks of the inertial guidance systems by lazing with the HEL to an inertial point above the horizon (e.g., upward at a star). These star shots may be part of any of the HEL operations.

Additional flight tests with the BQM-34 (a remote-controlled [drone] vehicle) would be flown to test the ARS, BILL, TILL and HEL systems. The BQM-34 drones would be used at WSMR, China Lake NAWC, or Point Mugu as outlined in the *Program Definition and Risk Reduction Phase of the Airborne Laser Program Environmental Impact Statement (1997).*

Up to 35 missile flight tests utilizing solid or liquid propellant missiles would occur at WSMR using WSMR restricted airspace, Federal Aviation Administration (FAA) controlled airspace, and airspace utilized by Fort Bliss. Missiles would be launched from existing approved launch areas. Approximately ten of these flight tests would involve testing the ARS, BILL, TILL, and SHEL systems. The remaining 25 tests would also incorporate the HEL. Lasing activities during flight tests at WSMR would involve the ABL aircraft flying outside of restricted airspace and firing the lasers at targets within WSMR restricted airspace.

Up to 25 missile flight tests would occur at the Western Range used by Vandenberg AFB. Missiles would be launched from Vandenberg AFB from launch areas analyzed in the *Theater Ballistic Missile Targets Final Programmatic Environmental Assessment (EA) (1997)* to test the ARS, BILL, TILL, and HEL systems.

Interwoven with the proposed standard flight tests, additional activities would be done to use the ABL detection, tracking, and communications capability. The ABL could be used to track other targets of opportunity. Targets of opportunity come in two forms. The first is a simple infrared signal given off by a moving military article (aircraft, missile, or similar vehicle) that can be passively observed with the IRST, and, in the case of unmanned target vehicles, the BILL/TILL/ARS lasers. The second type is for a missile or similar vehicle that is unmanned and the target can handle the flash of the HEL (similar to the MARTI HEL activities where a simple flash is done to the target without destroying it). The IRST and the lower-power lasers may also be used to detect, track, and monitor flights from other BMDS operations as opportunities became available. During exercises, these same systems would be used to track the targets. In addition, the HEL could flash the targets in a manner similar to the HEL MARTI tests.

Testing - Technology Improvements

The primary focus of this testing would be verifying the effectiveness and suitability of the upgraded laser fluid management system (ground testing), deployable support equipment, flight testing of capabilities deferred from the first ABL, and participation in BMDS System Integration Tests. Additional efforts may focus on weapon system effectiveness at negating extended range ballistic missiles if targets are available.

Testing - Second ABL

The second ABL testing would be similar in scope and concept to the first ABL testing. With the modification of a new aircraft into the upgraded configuration, the same complete weapon system verifications would have to be accomplished. In future testing, the SIL would be transitioned to a permanently based hardware-in-the-loop "Iron Bird" facility (i.e., a laser module and beam control test facility and lethality cell). Future testing would also include testing on the Iron Bird. These system-level ground tests would complement the flight test efforts from the technology improvement tests to assure system readiness for integration onto the second aircraft. The Iron Bird would also be used for continuing design and component upgrade testing. The second ABL testing would continue building on the lethality demonstrations from prior Blocks to arrive at a measure of the ABL's lethality. After completion of weapon system validation, the second ABL would also be used in the BMDS System Integration Tests. This additional testing is expected to take approximately 24 months.

Deployment

Following flight testing, this aircraft would be capable of providing, if directed, an emergency operational capability that offers limited rudimentary protection against ballistic missile threats in a regional crisis situation. Subsequent activity would involve enhancing ABL software and hardware on the first aircraft and would add deployable ground support equipment, including chemical production and storage facilities to produce the required laser fuel, to allow for forward deployment of the ABL as a weapon.

Decommissioning

Decommissioning of ABL facilities and equipment would involve demilitarizing or disposing of the aircraft and aircraft support facilities, the laser weapon components, chemical production and storage facilities, sensors, and BMC4I assets as required by the appropriate regulations.

National Environmental Policy Act (NEPA) Analysis

The following NEPA analyses support the majority of ABL test and development efforts.

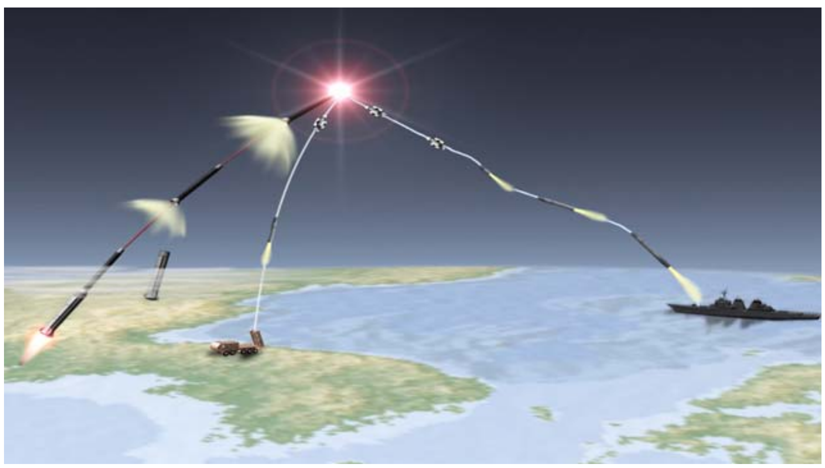
- *Airborne Laser Program Final Supplemental Environmental Impact Statement* (June 2003)
- *Point Mugu Sea Range Final Environmental Impact Statement/Overseas Environmental Impact Statement* (Department of the Navy, March 2002)
- *Program Definition and Risk Reduction Phase of the Airborne Laser Program Final Environmental Impact Statement* (April 1997)
- *Theater Ballistic Missile Targets Final Programmatic Environmental Assessment* (U.S. Air Force, December 1997)
- *Programmatic Environmental Assessment, Theater Missile Defense Lethality Program* (U.S. Army Space and Strategic Defense Command, April 1993)

D.2 Kinetic Energy Interceptor

Introduction

One MDA goal for Block 12 is to add a kinetic energy boost layer to the BMDS. There are two major efforts to achieve this goal. Development and Test (D&T) of a mobile, land-based boost ascent interceptor element and the Near-Field Infrared Experiment (NFIRE) risk reduction activity. MDA will complete development of a land-based, boost/ascent element in Block 12 (see Exhibit D-2 for an artistic depiction of terrestrial and sea-based concepts).

Exhibit D-2. Kinetic Energy Interceptor Terrestrial and Sea-Based Concepts



Development

In Fiscal Year (FY) 03 MDA awarded two contracts to design a mobile, boost/ascent element and propose a detailed plan to achieve this capability. Block 12 program priorities in rank order are mission assurance, schedule, performance and cost. These priorities resulted in the contractors proposing existing hardware, software and proven technologies in their design concept. During the Concept Design phase initial hardware-in-the loop testing of a kill vehicle seeker was completed, a full-scale prototype launcher was built and tested, the second-stage rocket motor with trapped-ball thrust vector control was static fired, real-time C2BMC/Fire Control experiments with Overhead Non-Imaging Infrared sensors were conducted, and a high-fidelity simulation of entire Kinetic Energy Interceptor (KEI) element concept was built and exercised. In December 2003, MDA awarded a contract for the KEI D&T Program to a defense contractor team.

The KEI land-based element design is based on mature technologies proven in ground and flight test at the component level. The KEI kill vehicle combines the Standard

Missile (SM)-3 seeker/avionics with an Exoatmospheric Kill Vehicle (EKV) liquid divert and attitude control system to achieve a high performance boost/ascent interceptor with inherent midcourse defense capability. The KEI third stage is a production SM-3 third stage rocket motor with a new attitude and control subsystem derived from Ground-based Midcourse Defense (GMD). The first and second stage motors utilize advanced solid axial stage technologies we have been developing and testing incrementally over the last decade. The C2BMC component builds upon an extensive suite of concept design phase algorithms and the contractor's substantial investments as lead developer of the GMD C2BMC capability. The mobile launcher is a modification of military-off-the-shelf equipment.

The KEI D&T program is structured much differently than predecessor missile defense programs. The D&T integrated master plan/integrated master schedule features an unprecedented mix of program content during the early years of execution. This content is driven by newly defined MDA engineering and manufacturing, software, and operational readiness level criteria. The MDA has defined the new readiness levels as exit criteria (knowledge points) for design reviews and the Block 12 capability milestone. MDA's objective is to focus early development work on manufacturing, producibility, quality, affordability, and operational suitability in addition to the traditional upfront emphasis on technical performance. The FYs 04 to 08 D&T program content includes: 1) mitigation of key risks through early build and test of full scale prototypes based on mature technologies, 2) complete definition of all requirements and interfaces by Design Review-1, 3) design of the interceptor, C2BMC, and launcher production lines, 4) establishment of machines and tooling in a laboratory environment for selected items, 5) development of engineering models as flight test unit pathfinders, 6) initiating builds of all integration labs and activating test facilities, 7) initiate procurement of flight test targets, and 8) extensive involvement of the User (STRATCOM, NORTHCOM) in KEI capability design and operations concept definition. Work will be conducted across multiple geographic centers where the integrated product teams are based.

Mobility of the interceptor is an essential characteristic enhancing its military utility. The KEI contractor is developing a canisterized interceptor, which is completely common to both land and sea basing and compatible with land and sea environments. These attributes will provide both flexibility and robustness to the test program, and ease the transition to a fully integrated sea based capability.

The collection of the near field infrared measurements of boosting targets will be from an on-orbit satellite. Currently, MDA is building the NFIRE satellite. The major objective of this effort is to collect near field long, medium and short wave infrared measurements of the rocket plume and body in the boost phase of flight to anchor our understanding of the plume phenomenology and plume to rocket body discrimination. MDA will also use this data to validate the models and simulations that are fundamental to developing the

navigation, guidance and control and endgame homing algorithms for the KEI D&T program.

Testing – Block 2012

Land-based Kinetic Energy Interceptor

Developing a realistic, robust test program for the BMDS Interceptor element is paramount to the BMDS. Beginning in FY 08 the interceptor will be tested from both land-based ranges and a sea-based platform. Launching the interceptor from a sea-based platform is critical to providing realistic coverage of the operational envelope and intercept geometries. Based on results of a Military Sealift Command market survey, the agency, through Military Sealift Command, will acquire a containership to support the BMDS interceptor testing. While serving to enhance the flexibility of the BMDS test bed, the containership may be deployed in case of a national emergency.

MDA will execute a series of two flight tests (Element Characterization Flight and Ship-launched Risk Reduction Flight) and five Integrated Flight Tests (1-5) against targets during the D&T. These flight tests will be preceded by a robust series of ground testing including multiple static fire tests of all three rocket motor stages and integrated Kill Vehicle hover testing as well as a Booster Flight test, a Partial Full Scale flight test and a Control Test Vehicle flight test. Numerous integrated GTs of the Element C2BMC with the BMDS and the Element C2BMC with the launcher will also be conducted. All five Integrated Flight Test missions will have the objective of intercepting the target. Beginning with Integrated Flight Test-3, the element will be tested using production hardware and software with Integrated Flight Test-5 mission conducted by the user. To support this strategy MDA will procure nine targets (including two spares).

Block 12 testing focuses on boost/ascent phase intercept. Technical and operational issues resolved during land-based development and testing mitigate risks for future evolutions of this mobile and highly effective capability.

MDA continues to conduct a disciplined approach to collecting data to better understand the physics and phenomenology of boosting flight. This measurements test program exploits existing targets of opportunity flights such as intercontinental ballistic missile and space launches through the use of ground, aircraft-borne and space based sensors. The importance of these data products enables improvements to be made to guidance algorithms, scene generation fidelity levels, and modeling and simulation results that are used to analyze interceptor performance capabilities against various threat type characteristics to include plume to hard body discrimination under different scenarios. MDA intends to conduct additional target of opportunity flights, varying the geometries of the flight test scenarios and instrument set-ups to improve the fidelity of data sets to include near field data needs throughout boost.

Two payloads will be integrated onto the NFIRE satellite to execute four missions. The first mission set tracks ground targets such as forest fires, volcanoes, and static tests of rocket engines. This mission will verify, on-orbit, the pointing accuracy of the gimbaled system and calibrate the tracking sensors. The second mission set tracks targets of opportunity worldwide that take place regardless of the NFIRE experiment. These might include aircraft flights, space launches and operational missile tests. The two primary missions require the spacecraft to maneuver to view a boosting intercontinental ballistic missile closing on the spacecraft. During the second of these two missions, the spacecraft releases the kill vehicle for a fly-by of the burning missile.

Deployment

The KEI program office will develop deployment plans in the event the DoD makes a positive deployment decision. MDA plans to deploy KEI only to the BMDS test bed.

Decommissioning

The program office will develop decommissioning plans in the event the DoD makes a positive deployment decision.

NEPA Analysis

Planning for NEPA analysis is underway for range, facility, and early test events.

D.3 AEGIS Ballistic Missile Defense

Introduction

The Aegis Ballistic Missile Defense (BMD) is a sea-based element designed to negate ballistic missiles in the midcourse flight phase and provide surveillance and tracking support to the BMDS against ballistic missiles of all ranges. Aegis BMD uses hit-to-kill technology to intercept and destroy short- to medium-range ballistic missiles. Future development would expand to use hit-to-kill technology to counter intermediate-range ballistic missiles. Currently, the focus of Aegis BMD is to counter ballistic missile threats in the midcourse phase. Future flight tests would address the element's ability to intercept ballistic missile lower in the exoatmosphere.

Aegis BMD components consist of a select number of Aegis Guided Missile Cruisers and Destroyers employing the AN/SPY-1 Radar with SM–3 missiles. Designated Aegis destroyers are being equipped ships would be modified to provide Long Range Surveillance and Tracking and will eventually be modified to support engagement with SM-3 missiles. Designated Aegis cruisers are being modified to support engagement.

Interceptors

The Aegis BMD midcourse defense element of the BMDS integrates the SM-3 with the existing Aegis Weapons System aboard Navy cruisers to provide protection against short- to medium-range ballistic missiles. The SM-3 is based on the SM-2 Block IV airframe and propulsion stack, but incorporates a third stage rocket motor, a Global Positioning System/Inertial Navigation System guidance section, and the SM-3 kinetic warhead. The SM-3 is a solid propellant-fueled, tail-controlled, surface-to-exoatmosphere missile.

The SM-3 is an evolution of the Lightweight Exoatmospheric Projectile developed in the mid-1980s to demonstrate hit-to-kill technology. The Aegis Weapons System's SPY-1 Radar detects and tracks a ballistic missile and passes that information to the SM-3. The SM-3 is launched from the vertical launch system and controlled by the Aegis Weapon System up to the kinetic warhead ejection from the third stage rocket motor. The Global Positioning System/Inertial Navigation System guides the missile on an intercept trajectory. The kinetic warhead is equipped with propulsion, a long wave infrared seeker, and a guidance and control system enabling it to acquire, track, discriminate, divert and intercept a ballistic missile target above the Earth's atmosphere.

Aegis Cruisers and Destroyers

The Aegis BMD element builds upon the existing Aegis weapons system and the SM infrastructure currently deployed on both Ticonderoga class cruisers (see Exhibit D-3) and Arleigh Burke class destroyers.

Exhibit D-3. Aegis Cruiser USS LAKE ERIE

AN/SPY-1 Radar

The AN/SPY-1 radar, S-band multi-function phased array radar is the primary sensor for the Aegis BMD. The radar is capable of search; automatic detection; transition to track; tracking of ballistic missiles, air and surface targets; and missile engagement support.

The AN/SPY-1 radar is computer-controlled, four-faced, phased array radar that rapidly transitions detections into tracks and passes them to the ship's Command and Decision system element for engagement decisions and further processing. The four fixed arrays of the radar send out beams in all directions, continuously providing a search and tracking capability for multiple targets at the same time. All targets tracked by the AN/SPY-1 radar are monitored by the ship's Command and Decision system. The Aegis BMD system development and testing has been integrated with the BMDS Test Bed and architecture to support MDA's capability-based block acquisition strategy.

Development

The Aegis BMD development began with the TERRIER Lightweight Exoatmospheric Projectile Program, which included four flight tests between 1992 and 1995, and demonstrated that Lightweight Exoatmospheric Projectile could be integrated into a sea-based tactical missile for BMD based on exoatmospheric intercepts.

The next step in program development was the Aegis Lightweight Exoatmospheric Projectile Intercept project that built upon the lessons learned from the TERRIER-Lightweight Exoatmospheric Projectile program and emerging technologies. The purpose of the Aegis Lightweight Exoatmospheric Projectile Intercept was to demonstrate technologies required to hit a ballistic missile target in the exoatmosphere from a ship at sea. The project test requirements were satisfied with two successful intercepts from the USS LAKE ERIE: Flight Mission (FM)-2 and FM-3 in January 2002 and June 2002, respectively. FM-2 accomplished a direct hit of a ballistic missile target and successfully demonstrated kinetic warhead guidance, navigation, and control operations against a live target. FM-3 successfully repeated the intercept of a live ballistic missile target. With the successful completion of FM-3, the Navy considers the exit criteria of the Aegis Lightweight Exoatmospheric Projectile Intercept project to have been met.

Current developmental efforts for Aegis BMD Block 2004 are focused on defeating short- and medium-range ballistic missiles while providing surveillance support to the BMDS. Block 2004 delivers the Aegis BMD capability to provide long-range surveillance and tracking against intermediate range and intercontinental ballistic missiles to other components of the BMDS. Aegis BMD flight-testing includes a series of test FMs that demonstrate increasingly complex capability against ballistic missiles such as testing against unitary targets, separating targets, separating targets in clear environments and separating targets that include countermeasures.

The operational objective of the Aegis BMD Block 2004 Test Bed capability is to act synergistically with other BMDS boost, midcourse, and terminal elements to maximize BMD capability.

The Japan Cooperative Research project consists of joint research conducted by Japan and the U.S. to enhance the capabilities of the SM-3 for BMD. This program is part of the U.S. security alliance with U.S. allies to complement the incremental capability approach. The focus of research is on four components of the SM-3 guided missile - sensor, advanced kinetic warhead, second stage propulsion, and lightweight nosecone. Initial flight-testing will test advanced nosecone functionality, which may be integrated into the Aegis BMD Block 2006 capability.

Testing – Block 2004

The Aegis BMD program test strategy consists of coordinated ground and flight-testing to verify the expanding capabilities of the system's evolutionary block development. The Block 2004 flight test program is designed to demonstrate capability against an increasingly complex range of ballistic missile targets. These flight tests provide the opportunity to demonstrate both midcourse ascent and descent phase intercept capability and to flight test the divert-and-attitude control system kinetic warhead. Block 2004 FMs will demonstrate the capability to tactically engage unitary ballistic missile targets including one in the low exoatmosphere as well as demonstrate an initial capability against simple separating ballistic missile targets.

Aegis BMD has developed the capability to deliver long-range surveillance and tracking support to the BMDS and GMD. As part of this development, Aegis BMD Blocks 04 and beyond participates in all GMD Integration Flight Test missions and System Integration Flight Test (SIFT) missions to provide a long-range surveillance and tracking capability to GMD. At some point in Aegis BMD development, future blocks may participate in Integrated Flight Tests as an engagement asset (Block 08 or later). In the near term, Aegis BMD will be demonstrating connectivity between an Aegis ship in the Western Pacific and the BMDS.

Testing - Block 2006

The Block 2006 flight test program will demonstrate system capability improvements to defeat short range, medium range, and intermediate range ballistic missiles, enhanced discrimination, and will provide capability against countermeasures. The flight test program will include Launch on Boost in addition to Launch on Remote. Other plans for system improvements are under development including the Aegis BMD signal processor. Additionally, Japan Cooperative Research Project flight tests will be conducted to demonstrate the SM-3 lightweight nosecone.

Testing - Block 2008

Aegis BMD Block 2008 will provide fully integrated radar discrimination and other enhancements against Long Range Ballistic Missiles and countermeasures as well as continued upgrades for BMDS C2BMC. It will include multiple simultaneous engagement capability. Further details are being developed within MDA.

Testing - Block 2010

The Block 2010 flight test program will demonstrate a weapon system upgrade that will permit the incorporation of Aegis BMD into the Navy developed Aegis Weapon System

open architecture, thereby fully integrating BMD into the Aegis multi-mission capability. Additional performance in countermeasure environments will also be demonstrated.

Deployment

Deployment includes production, manufacture and fielding of the Aegis BMD elements and any test-related assets. At the conclusion of Block 2004, three Aegis BMD cruisers and 15 Aegis BMD destroyers will be modified. Deployment locations have not yet been determined.

Decommissioning

The U.S. Navy would decommission the Aegis cruisers or destroyers at the end of their useful life. Decommissioned ships may be overhauled and returned to service, sold to an Allied Navy through foreign military sales, or the ship may be sold for scrap metal. The disposition of all weapons and sensors would be in accordance with applicable DoD and U.S. Navy policy.

NEPA Analysis

The following NEPA analyses support the majority of Aegis BMD test and development efforts.

- *Rim of the Pacific Programmatic Environmental Assessment* (June 2002)
- *Point Mugu Sea Range Final Environmental Impact Statement/Overseas Environmental Impact Statement* (Department of the Navy, March 2002)
- *Pacific Missile Range Facility Enhanced Capability Final Environmental Impact Statement* (December 1998)
- *Lightweight Exoatmospheric Projectile Test Program Environmental Assessment* (June 1991)

D.4 Ground-Based Midcourse Defense

Introduction

The GMD segment of the BMDS is comprised of ground-based interceptor missiles, radars and other sensors, and GMD Fire Control (GFC) Node and is designed to neutralize a threat ballistic missile during the midcourse phase of its flight. The midcourse phase is best defined as the ballistic portion of a missile's flight after it leaves the atmosphere and before it reenters the atmosphere. An operational GMD within the proposed BMDS includes the following key components

- Ground-Based Interceptors (GBIs),
- Sea-Based X-Band Radar (SBX),
- Ground-Based Midcourse Defense Fire Control/Communications (GFC/C) facilities and links, and
- Upgraded Early Warning Radars (UEWRs).

Sensors

Sensors proposed for the GMD include the SBX, UEWR (e.g., COBRA DANE on Eareckson Air Station, UEWRs at Beale AFB, Royal Air Force Fylingdales, and Thule Air Base), AN/SPY-1 Radar, BMDS Radar (Forward Based X-band Transportable[FBX-T]), AN/FPQ-14 Radar, and space-based sensors. The GMD program also uses sensors from other elements of the BMDS. See Appendix E for a detailed description of the BMDS sensors.

Interceptors

The GBI is designed to intercept incoming ballistic missile warheads outside the Earth's atmosphere and destroy them through force of impact. The GBI consists of a multi-stage solid propellant booster and an EKV. Each interceptor booster contains up to approximately 20,500 kilograms (45,000 pounds) of solid propellant.

During flight, the GBI receives information from the GFC/C to update the location of the incoming ballistic target, enabling the EKV's onboard sensor system to identify and home in on the threat re entry vehicle. Each EKV contains approximately 7.5 liters (2 gallons) of liquid monomethyl hydrazine fuel and 7.5 liters (2 gallons) of liquid nitrogen tetroxide oxidizer. The liquid fuel and liquid oxidizer tanks arrive at GMD test and operational sites fully fueled. Interceptors are assembled on site.

The components associated with a typical GBI launch site include the Launch Control Center, range sensors, and In-Flight Interceptor Communications System Data Terminal

(IDT). The Launch Control Center is linked to the GBI silo via fiber optic cable and contains computer terminals and the flight control center. Range sensors and telemetry equipment are used to monitor all missile flights. The IDT provides an in flight tactical or communications link between the GFC/C and the interceptor during flight. Each GMD site uses commercial power with electrical generators for backup power.

Interceptor missile boosters, payloads, and support equipment will be transported by air, ship, or over-the-road common carrier from U.S. Government storage depots or contractor facilities to the test range. Shipping is conducted in accordance with Department of Transportation (DOT) regulations. The interceptor will be placed in existing or newly constructed facilities for assembly and launch preparation. Applicable safety regulations are followed in the transport, receipt, storage, and handling of hazardous materials. An appropriate explosive safety quantity distance (ESQD), as approved by the DoD Explosives Safety Board, surrounds facilities where interceptors and ordnance are stored or handled.

Ground-Based Fire Control/Communications

The GFC/C facilities and links are presented below in two categories: 1) GFC command nodes, and GFC communications links, which include the Ground Based Communications Network, and 2) the IDTs.

GFC Command Nodes

The existing and proposed GFC command nodes with their related facilities and hardware exist or are under construction at identified locations for either test or operational purposes.

The command level GFC/C sites are located at the Joint National Integration Center and Fort Greely. GFC/C sites will be operational 24 hours a day.

Execution level GFC/C nodes are located at GMD GBI sites and use electric power from the base or GBI site. The operational concept is for GFC/C to consist mostly of battle management functions and to act as the centralized point for readiness, monitoring, and maintenance. GFC/C provides the user with system status displays, threat displays, predictive planning displays, and weapons control data to support both GMD and BMDS level command and control decision-making and execution.

The sensor level site communications node is co-located with the sensor or, in the case of spaced-based sensors, at the appropriate satellite control center to communicate sensor data to the GFC/C network.

GFC/C system sites may include

- Peterson AFB, Colorado (Command Level Node),
- Schriever AFB, Colorado (Command Level Node),
- Cheyenne Mountain Complex, Colorado (Command Level Node),
- Beale AFB, California (Sensor Level Site Communications Node),
- Eareckson Air Station, Alaska (Sensor Level Site Communications Node),
- Fort Greely, Alaska (Execution Level Node),
- Vandenberg AFB, California (Execution Level Node),
- Thule Air Base, Greenland (Sensor Site Communications Node), and
- Royal Air Force Fylingdales, England (Sensor Site Communications Node).

These GFC/C nodes use existing facilities where available. These existing facilities usually only require minor modifications, hardware and software upgrades, and connections to existing communications lines. However, some sites require new facility construction, such as satellite earth terminals or new utility or communications lines.

GMD Communications Network

The GMD Communications Network is that portion of the GFC/C component that provides voice and data communications through a network of transmission equipment and circuits, cryptographic equipment, and local and wide area networks necessary to provide a dedicated, reliable, and secure GMD communication capability. Components of the network provide connectivity to all components of the test bed and for limited defensive capability (LDC), providing functional connectivity to the IDTs, the GBI and target launch facilities, radars, and the GFC/C system. Communications occur over a combination of existing and new communication cables (either fiber optic or copper), Military Satellite Communications (MILSATCOM) and Commercial Satellite Communications (COMSATCOM) terminals.

Satellite Communications

The primary power for MILSATCOM and COMSATCOM Earth Terminals (see Exhibit D-4) is commercial, with backup power provided by generator. Communication cables between the terminal and the launch control complex are required. Equipment can be housed in a military van, a small building, or an existing facility if an adequate structure is available. The site requirements include a concrete base for the Earth Terminal, an all-weather road to the site, a prepared surface and fencing around the site.

Exhibit D-4. COMSATCOM Earth Terminal

Communications Cable

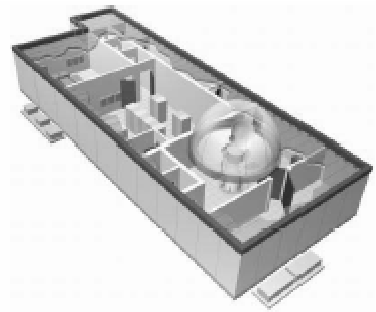
For communication among the components on the same installation, the test bed maximizes available communications assets, including existing cable. If communication cable is not available, new cable will be installed. New cable uses existing conduit, if available. If existing conduit is not available, new conduit is laid using existing rights-of-way, where possible to avoid environmental concerns. Where new conduit is necessary, it requires a trench approximately one meter (three feet) wide and one meter (three feet) deep.

In-Flight Interceptor Communication System Data Terminals

The IDT provides communications links between a GBI missile in flight and GFC/C systems. IDTs are located close to GBI launch sites and at remote locations. See Exhibit D-5 for conceptual examples of these alternative IDT configurations. GMD may employ more than one of these IDT configurations to meet testing or future deployment requirements.

The IDT is a radio transmitter and receiver that functions only during GMD and BMDS exercises, test events and missions. It is a super high frequency transceiver that provides communications uplink and downlink between the GFC/C nodes and the in-flight GBI.

Exhibit D-5. In-Flight Data Terminals



Development

As one of the more mature elements of the BMDS, GMD has been under development for a number of years. Currently, GMD is in the LDC phase of development at Fort Greely, Alaska, Vandenberg AFB, California, and at several other locations.

Testing

GMD testing involves increasingly robust interceptor flight tests with participation of additional BMDS components to achieve more realistic testing. Enhanced flight testing requires the extension of existing Pacific Region test range areas that currently support BMDS test activities. The Extended Test Range (ETR) provides increased realism for GMD/BMDS testing by allowing multiple missile engagement scenarios, trajectories, geometries, distances, and target speeds that more closely resemble those an operational BMDS is likely to encounter. Most tests include launching a target missile; tracking by range and other land-based, sea-based, airborne, and space-based sensors; launching a GBI; and missile intercepts at high altitudes over the Pacific Ocean. Some test events

include multiple target and interceptor missile flights to validate BMDS performance, as well as testing from existing test or operational sites in compliance with Federal, state and local regulations.

Target missiles could be launched from Ronald Reagan Ballistic Missile Defense Test Site (RTS) at U.S. Army Kwajalein Atoll (USAKA) in the Marshall Islands; Vandenberg AFB, California; Pacific Missile Range Facility (PMRF) on Kauai, Hawaii; and/or from mobile platforms situated in the Pacific Ocean. GMD's existing deployed sites also may be involved in test firing and other test activities to assess system performance. Exhibit D-6 shows these and other test and test support locations. Interceptor missiles may be launched from RTS, Kodiak Launch Complex (KLC), Alaska, and/or Vandenberg AFB, California. Dual target and interceptor missile launches may occur in some scenarios. Existing, modified, and new infrastructure support launch activities at the various locations.

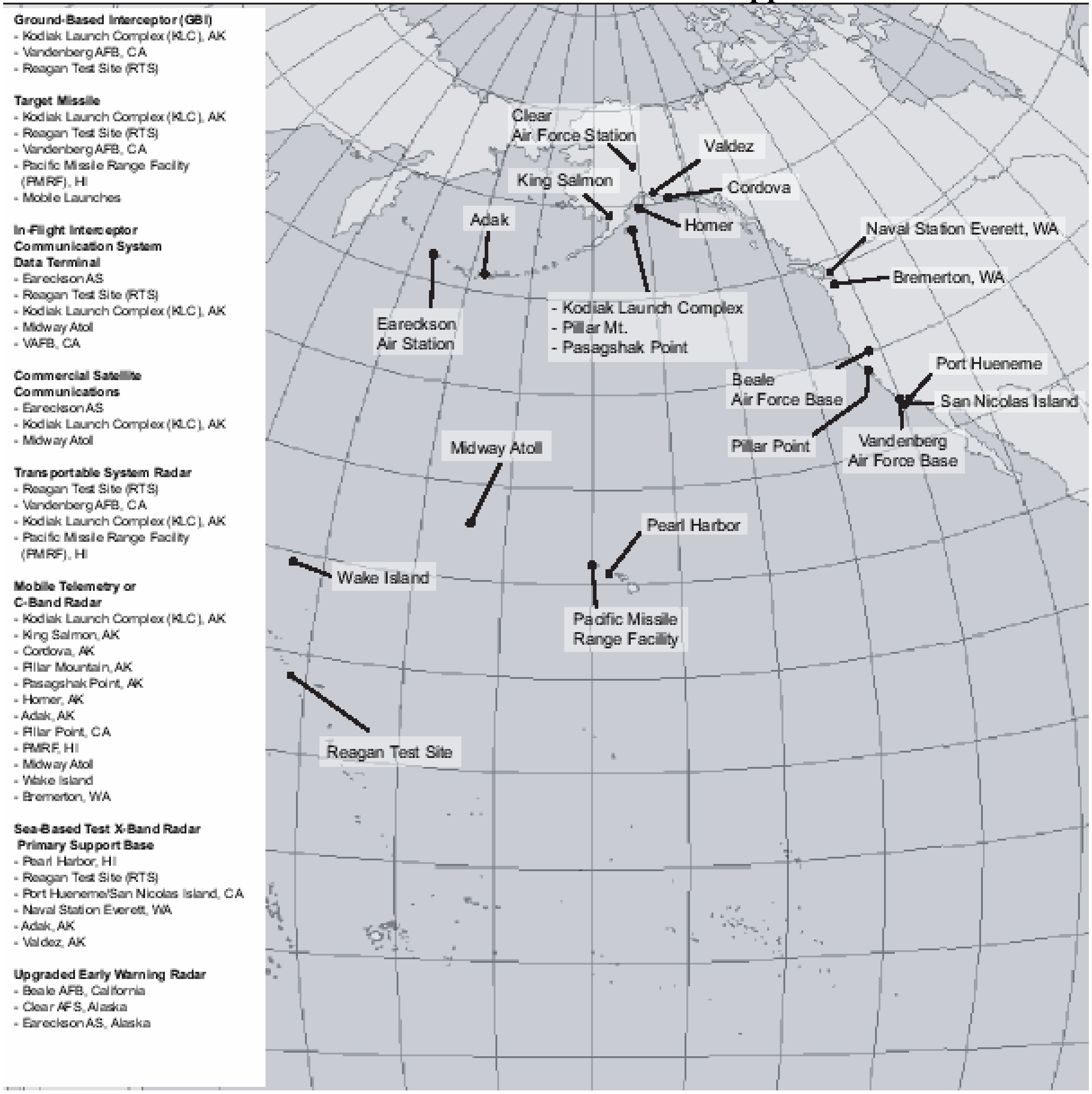
Target missile acquisition and tracking would be provided by sea-based sensors (e.g., Aegis cruisers and destroyers, SBX) and land-based sensors in the Pacific Region; a transportable test X-band radar (TPS-X) or the forward deployed radar (FDR) positioned at test ranges such as Vandenberg AFB, KLC, RTS, or PMRF; the existing prototype X-band Ground Based Radar (GBR-P) at RTS; and existing/upgraded radars at Beale AFB, California, Clear Air Force Station, Alaska, and Eareckson Air Station, Alaska (see Exhibit D-6).

IDTs may be located at GBI launch sites. Satellite communications terminals will be constructed at launch sites that do not have fiber optic communication links and at other locations.

GMD test plans include a number of missile launches (interceptors and/or targets) from each launch facility per year. The total per year will vary to meet the needs of the program.

The GMD flight test program consists of various Integrated Flight Tests in which an intercept is attempted, and Radar Characterization Flights in which only a target vehicle is flown and observed by radars.

Exhibit D-6. MDA GMD ETR Test and Test Support Locations[3][4]



Source: GMD ETR EIS (July 2003)

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[3] At the time this graphic was originally published, the MDA was considering six sites for the location of the SBX Primary Support Base (i.e., Pearl Harbor, HI; Reagan Test Site; Port Hueneme/San Nicolas Island, California; Naval Station Everett, Washington; Adak, Alaska; and Valdez, Alaska). MDA has decided to establish the Primary Support Base at Adak, Alaska. (Record of Decision [ROD] To Establish a GMD ETR, August 26, 2003).

[4] At the time this graphic was originally published, the MDA was evaluating the potential impacts of launching interceptor missiles from the KLC; however, in a Record of Decision issued on December 9, 2003, the MDA determined that the activities proposed for the KLC would consist of dual target launches and no interceptor launches.

Testing - Block 2004

Block 2004 GMD element proposed actions include introduction of the SBX into the BMDS Test Bed to increase test capability and realism against more stressful long-range targets and countermeasures suites.[5]

Testing - Block 2006

Block 2006 GMD proposed actions include prototype hardware and software maturation for all GMD interceptor, sensor, and GFC/C components; ground and flight-testing to demonstrate added performance, and interfaces with external sensors; and the upgrade of theearly warning radar (EWR) at Thule Air Base, Greenland.[6]

Testing - Block 2008

Block 2008 GMD proposed actions include demonstrating advanced engineering and pre-planned equipment improvements for boosters, interceptors, early warning and fire control radars, and GFC/C software builds; and demonstrating improved performance based on overall enhancements to BMDS integration, including KEI and space-based sensors.[7]

Testing - Block 2010

Block 2010 GMD-proposed actions include continued flight-testing of improved weapon and sensor components, and design, engineering and integration of an advanced KEI.[8]

Deployment

In light of the new security environment and advances made to date in missile defense development, the President directed the DoD to field limited defensive capabilities by the end of 2004 to meet growing ballistic missile threats.

The initial set of GMD capabilities planned for 2004-2005 included as many as 16 GBIs at Fort Greely, Alaska and two interceptors at Vandenberg AFB, California. Additionally, the GMD element of the BMDS will take advantage of land-, sea-, and space-based sensors, including existing early warning satellites and an upgraded radar located at Eareckson Air Station, Alaska, and the SBX. MDA also plans to upgrade EWRs at Cape Cod and in the United Kingdom and the Kingdom of Denmark.[9]

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[5] MDA FY 2004/2005 Budget Estimate Submission Press Release (page 11)
[6] Ibid. (page 13)
[7] Ibid. (page 16)
[8] Ibid. (page 17)
[9] DoD Press Release, December 2002

The exact nature of future GMD deployment activities (i.e., additional interceptors, land-based radars, and the construction of necessary support facilities) has yet to be determined. Any decision to deploy additional interceptors would be addressed in additional NEPA analysis or the appropriate analysis under Executive Order (EO) 12114, if appropriate. Currently, the Initial Defensive Operations (IDO) capabilities Record of Decision (ROD) dated April 18, 2003, supports deployment of as many as 40 interceptors at Fort Greely, Alaska.[10]

Decommissioning

Decommissioning of all or part of the GMD element is dependent on many variables. The exact timing of decommissioning activities has not been determined. The decommissioning of GBI missiles and the demolition of GMD element facilities (e.g., silos, radar buildings, etc.) will be in accordance with the applicable environmental regulations and standard practices. The decommissioning effort will seek to reuse and recycle materials to the maximum extent possible.

NEPA Analysis

The following NEPA analyses support the majority of GMD test and development efforts including establishment of the IDO capability.

- *Ground-Based Midcourse Defense Extended Test Range Final Environmental Impact Statement* (July 2003)
- *National Missile Defense Deployment Final Environmental Impact Statement* (July 2000)
- *Ground-Based Midcourse Defense Initial Defensive Operations Capability at Vandenberg AFB Environmental Assessment* (August 2003)
- *Alternate Boost Vehicle Verification Tests Environmental Assessment* (August 2002)
- *Ground-Based Midcourse Defense Validation of Operational Concept Environmental Assessment* (March 2002)
- *Ground-Based Midcourse Defense Supplemental Validation of Operational Concept Environmental Assessment* (December 2002)
- *Exoatmospheric Kill Vehicle Final Assembly and Checkout Operations at Redstone Arsenal, Alabama Environmental Assessment* (March 2000)
- *Integration, Assembly, Test, and Checkout of National Missile Defense Components at Redstone Arsenal, Alabama Environmental Assessment* (February 1999)
- *Additional Facilities at the National Missile Defense Ground-Based Interceptor Development and Integration Laboratory, Huntsville, Alabama Environmental Assessment* (March 1999)

[10] MDA, DoD. ROD to Establish GMD IDO Capability at Fort Greely, Alaska, April 18, 2003.

- *Booster Verification Tests Environmental Assessment, Vandenberg AFB* (March 1999)

Related Environmental Documentation

- *North Pacific Targets Program Environmental Assessment* (April 2001)
- *Theater Ballistic Missile Targets Programmatic Environmental Assessment* (December 1997)
- *Kodiak Launch Complex Environmental Assessment (May 1996)*

D.5 Patriot Advanced Capability-3

Introduction

PATRIOT is a mobile and transportable ground-based missile defense element that would be part of the terminal defense segment of the BMDS. PATRIOT is capable of multiple simultaneous engagements of the full range of short- and medium-range threats, including theater and tactical ballistic missiles, cruise missiles, tactical air-to-surface missiles including anti-radiation missiles, and lower radar cross-section aircraft flying in clutter and/or intense electronic countermeasure environments. PATRIOT defends deployed forces, strategic assets, and population centers in military operations. PATRIOT is designed to be able to communicate and operate with other elements, such as Terminal High Altitude Area Defense (THAAD) and Arrow, and the BMDS.

The PATRIOT uses PAC-3 and PAC-2 Guidance Enhanced Missiles as interceptors. The PAC-3 interceptor is a hit-to-kill guided missile with an onboard radar seeker and an explosive lethality enhancer. The PAC-2 Guidance Enhanced Missile interceptor is a guided missile with upgraded software to improve guidance of the missile and an onboard radar seeker and an explosive fragmentation warhead that detonates in close proximity to the target.

PAC-3 Missile

The PAC-3 missile (see Exhibit D-7) uses a solid rocket motor, aerodynamic controls, and a guidance system to navigate to an intercept point specified by the Fire Solution Computer prior to launch. Shortly before reaching the intercept point, the onboard radar acquires the target and the missile maneuvers to intercept the target. The control necessary for these maneuvers is provided by an Attitude Control Section. A lethality enhancer may be deployed near intercept to further increase the probability of destroying air-breathing targets.

Exhibit D-7. PAC-3 Launch

The PAC-3 missile consists of the seeker assembly, Attitude Control Section, Mid Section Assembly, solid rocket motor Section, and the Aft Section Assembly.

The seeker assembly is mounted at the forward end of the PAC-3 missile. It consists of a protective ceramic cover called a radome, active Ka Band Radar that acquires the target, an aluminum and graphite composite assembly and housing, the onboard radar, and associated electronics.

The Attitude Control Section contains a number of small, short duration, solid propellant (aluminum and ammonium perchlorate and hydroxyl-terminated polybutadiene) rocket motors (side thrusters) that enable the PAC-3 missile to maneuver to achieve an intercept of a target in response to the instructions provided by the onboard guidance processor. The Attitude Control Section housing and assembly is a composite material made of aluminum and graphite. The Attitude Control Section also contains one lithium thermal battery.

The mid section assembly contains various guidance, control, and communications electronics and antennas mounted in aluminum and graphite composite housing and assembly. The mid section assembly also contains a lethality enhancer to further increase the kill probability at intercept. The lethality enhancer contains various standard explosives, standard explosive detonators, two lithium thermal batteries, and a number of steel fragments. The main explosive charge is a low explosive that has been fully qualified for production and operational use. The lethality enhancer also serves as the Missile Destruct System for the PAC-3 missile. In the event that the PAC-3 missile diverges from a safe trajectory, the missile operator in the Engagement Control Station can command the lethality enhancer to detonate, breaking up the airframe of the missile, terminating thrust of the solid rocket motor, and causing it to terminate its flight and fall as debris.

The solid rocket motor Section includes the single stage solid rocket motor, fixed fins, pyrotechnic motor initiators, and a graphite composite case. The fixed fins are titanium and are secured to the rocket motor casing by titanium attachments. The solid rocket motor contains approximately 160 kilograms (350 pounds) of solid propellant (aluminum and ammonium perchlorate and hydroxyl-terminated polybutadiene).

PAC-2 Missile

The PAC-2 missile is equipped with four clipped-delta movable control surfaces mounted on the tail. The missile propulsion is furnished by a single-grain solid propellant rocket motor. A high explosive warhead provides target-kill. The PAC-2 missile would consist of the radome, guidance section, warhead section, propulsion section, and the control actuator section.

The radome provides an aerodynamic shape for the missile and microwave window and thermal protection for the Track-via-Missile seeker and electronic components. The guidance section consists of a Modular Digital Airborne Guidance System and is comprised of two parts. The Modular Midcourse Package, which is located in the forward portion of the warhead section, consists of the navigational electronics and a Missile Borne Computer which computes the guidance and autopilot algorithms and provides steering commands in accordance with a resident computer program. The Terminal Guidance section is the Track-via-Missile seeker, which consists of an antenna mounted on an inertial platform, antenna control electronics, a receiver, and a transmitter.

The propulsion section is comprised of the rocket motor, external heat shield, and two external conduits and contains a conventional, case-bonded solid propellant.

The control actuator section is located at the aft end of the missile. It receives commands via the missile autopilot and positions the fins to steer and stabilize missile flight. The fin servo system consists of hydraulic actuators and valves and an electrohydraulic power supply consisting of battery, motor-pump, oil reservoir, gas pressure bottle, and accumulator.

Development

The U.S. Army first introduced the PATRIOT air defense system in 1983, and the PATRIOT system was fielded in Europe in the mid 1980's. Continuous improvements and upgrades have been made to enhance its ability to counter evolving threats. The PATRIOT system was used to defend against Iraqi scud missiles in 1991 during Operation Desert Shield and Operation Desert Storm. The PATRIOT system was again utilized to defend against Iraqi missile threats in 2003 during Operation Iraqi Freedom.

By the end of Block 2004 the PATRIOT force will include 735 PAC-2 Guidance Enhanced Missiles and 364 PAC-3 Missiles, 30 PATRIOT AN/MPQ-53 Radars and 43 PATRIOT AN/MPQ-65 Radars, and PATRIOT Battle Management/Command and Control (BMC2) (Information and Coordination Central Control Units/Engagement Control Stations) to provide defense against short range and medium range threats.

The PAC-3 program was formally transferred to the U.S. Army in FY 03. The Army became responsible for the development, testing, budgeting, operations, fielding, and sustaining functions for the PAC-3 program. MDA remains involved from the BMDS perspective including BMDS performance, integration, and system testing.

Testing

Testing falls into one of four test categories, pre-production test, ground test, flight test, and lethality/survivability test.

Pre-Production Test

The pre-production test includes production qualification tests and production conformation tests. These two types of tests involve subjecting the upgraded components to a standard battery of natural environment, induced environment, supportability, transportability, mobility, performance, and other sub-tests. Production conformation tests demonstrate that deficiencies discovered during production qualification tests are fixed and operating properly. Upon completion of production qualification tests, the upgraded components would be integrated into the system and the system would undergo system level ground tests.

Ground Test

Ground testing would include simulations and performance tests. Simulations would be used to predict and verify system performance. Performance tests would include Developmental Testing and Evaluation, Information Assurance, Search Track, Ground-to-Ground and Ground-to-Air, and Operational Demonstration. Developmental Testing and Evaluation would ensure that hardware and software upgrades to the system have been successfully integrated and are ready for operational testing. Information Assurance would evaluate the vulnerability of the software and information systems. Search Track testing consists of a series of integrated hardware and software tests using simulated and real targets, electronic countermeasures, and penetration aids. Ground-to-ground and ground-to-air tests allowed checkout of missile guidance functions against simulated and real targets prior to flight tests. An Operational Demonstration was performed to demonstrate the technical merits of the hardware and software when tested in an operationally realistic environment. Interoperability testing will assess upgrades that allow the PATRIOT system to interoperate and trade data with other BMDS Command, Control, Communications, and Intelligence platforms.

Flight Test Programs

The Counter Anti-Radiation Missile program will involve one flight test that would demonstrate that the PAC-3 element could detect, track, engage, and successfully intercept an Anti-Radiation Missile flying a threat representative trajectory. This flight test is planned to occur at WSMR, New Mexico.

The PATRIOT Service Life Extension Program would modernize and repackage the PATRIOT system to meet the requirement that the PATRIOT be transportable by C-130 aircraft. A flight test would demonstrate that the modifications can support system functionality to detect, track, threat process, engage, and intercept a threat representative target. The flight test would occur at WSMR during Block 2006 testing.

The Light Antenna Mast Group would be an improved, scaled-down version of the existing tactical PATRIOT Antenna Mast Group and is a sub-program of the Service Life Extension Program. A flight test would demonstrate that the Light Antenna Mast Group could support system functionality to detect, track, threat process, engage, and intercept a threat representative aerial target. The flight test would occur at WSMR during Block 2004 testing.

The Evolutionary Development Program would be a continuing process that results in Block Upgrades to the PATRIOT system. Initially there are 16 tasks foreseen, and three are still being evaluated. The Evolutional Development Program would test computer software and processing, sensors, communications, Command and Control/Battle Management, (C2BM) ability to counter evolving threats, and upgrades to the PAC-3 missile. Several flight tests are scheduled to occur at WSMR under this program during Blocks 2004 and 2006.

Ripple Fire testing to assess the ability of the two PAC-3 missiles fired successively to intercept two tactical ballistic missile targets was successfully accomplished in November 2004.

Lethality/Survivability Test

Requirements for lethality testing are still being addressed. Survivability testing would involve nuclear, biological, and chemical contamination survivability.

BMDS Testing

The PAC-3 element would play a role in SIFT 2-1 and SIFT 3. Information from other SIFTs could be used to construct overlay scenarios for the PAC-3 element. In SIFT 2-1, a launch would be detected by the Defense Support Program (DSP), which would notify C2BMC of the launch. C2BMC would pass cueing information to PAC-3. PAC-3 would place the incoming ballistic missile under track and engage from WSMR. Following the intercept PATRIOT would perform a hit assessment and inform C2BMC of the results.

Deployment

PAC-3 units are fielded, operated, and sustained within the U.S. Army and U.S. National Guard throughout the U.S. Up to four surveillance rounds will be fired per year during operation and fielding phases. PAC-3 operators and maintainers would receive initial and follow-up training. The PAC-3 units would be upgrades of existing PAC-2 units, resulting in minimal training impacts.

Routine field training in tactics, techniques, and procedures for PAC-3 fielded units would provide the PAC-3 operators the opportunity to realistically train against systems

similar to those likely to be encountered in a hostile environment. Field training activities occur at least on a weekly basis. Simulation training and live fire training will be conducted throughout the service life of the PAC-3 missile and system. Live fire training occurs at regular intervals, at qualified test ranges.

Decommissioning

The PAC-3 system is anticipated to be in the U.S. Army inventory for approximately 30 years. Upon reaching the conclusion of its U.S. Army effective service life, the system would be withdrawn from military service, decommissioned, and disposed. Some components could be evaluated for continued use by other U.S. Government agencies or as candidates for Foreign Military Sales. Various adaptive reuses could be analyzed and implemented if appropriate. If no appropriate requirements were identified, the PAC-3 units would be demilitarized and disposed of. Demilitarization is the act of destroying a system's offensive and defensive capabilities to prevent the equipment from being used for its intended military purpose. Disposal is the process of redistributing, transferring, donating, selling, abandoning, destroying, or any other disposition of the property.

Key items to be demilitarized include explosives; propellants and propellant fillers; toxic materials; incendiary or smoke content; other military design features; and any features determined to be hazardous to the general public. Items to be demilitarized include the entire missile or vehicle. To ensure freedom from explosive, toxic, incendiary, smoke, or design hazards, the process would be undertaken as economically as practicable and in accordance with existing environmental standards and safety and operational regulations.

PAC-3 system disposal would involve establishing disposal facility availability and shipping hardware to disposal site. Disposal of material would then conform to DoD directives, Joint Service Regulations, and comply with all Federal and state laws.

Each individual piece of equipment has disposition instructions that have been prepared by its development contractor or project office. These instructions identify the hazardous materials contained in the item of equipment. A copy of the disposition instructions would be provided to the depot or contractor performing the demilitarization and disposal. Disposal would be conducted according to the supplied disposition instructions in accordance with all federal, state, and local laws. Transportation of PAC-3 system components to demilitarization and disposal locations from military units, training, and maintenance locations would be by commercial ground transportation in accordance with DOT, state and local transportation and safety regulations and procedures.

NEPA Analysis

The following NEPA analyses support the majority of PATRIOT test and development efforts.

- *PATRIOT Advanced Capability-3 (PAC-3) Life Cycle Final Supplemental Environmental Assessment* (U.S Army Space and Missile Defense Command, January 2002)
- *PATRIOT Advanced Capability-3 (PAC-3) Life Cycle Environmental Assessment* (U.S. Army Space and Strategic Defense Command, May 1997)
- *PATRIOT Missile System, White Sands Missile Range, New Mexico Environmental Assessment* (U.S. Army, June 1995)
- *Theater Missile Defense Flight Test Supplemental Environmental Assessment* (U.S. Army Space and Strategic Defense Command, November 1995)

D.6 Terminal High Altitude Area Defense

Introduction

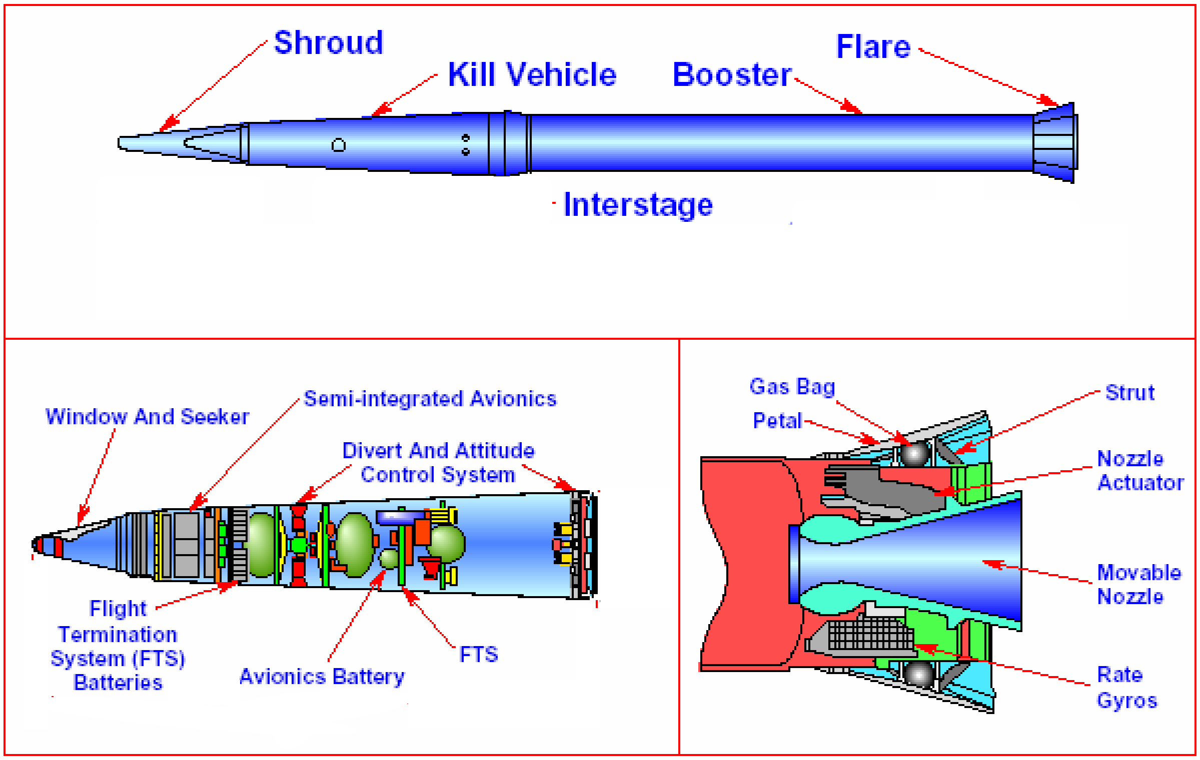
The THAAD weapons system is a mobile, land-based missile system designed to intercept and destroy short and medium range ballistic missiles in the endo- and exoatmosphere and to provide surveillance support to the BMDS against ballistic missiles of all ranges. The BMDS is envisioned as a system of layered, yet independent, defenses that use complementary interceptors, sensors and C2BMC to intercept ballistic missiles of all ranges in all phases of flight. The THAAD element would be integrated as part of the BMDS to provide protection against incoming ballistic missiles in the terminal phase of their flight. Complete with its own radar, launcher and C2BMC, the THAAD missile could operate independently as a BMDS or could be deployed as a sensor to provide surveillance and tracking of target missiles and to communicate data to other elements in the BMDS.

The THAAD missile system consists of four principle components: interceptor missiles, truck-mounted launchers, the THAAD radar system, and the THAAD C2BMC. All components of the THAAD missile system, with the exception of certain radar components, can be transported by a C-130 aircraft for deployment by sea, rail, and/or road.

Interceptor Missiles

The THAAD missile is intended to intercept and destroy incoming ballistic missiles with ranges of up to 3,000 kilometers (1,860 miles). The missile rounds are comprised of a single-stage booster attached to a kill vehicle. The THAAD kill vehicle includes an infrared seeker that detects and homes in on the target missile to destroy the target by high-speed collision. This hit-to-kill technology uses kinetic energy to eliminate the enemy missile. The kill vehicle consists of a shroud, fore-cone, seeker, divert and attitude control system, and guidance and control electronics. The kill vehicle has an uncooled sapphire window with an infrared seeker mounted on a two-axis stabilized platform. See Exhibit D-8 for an example configuration of a THAAD missile.

Exhibit D-8. Example THAAD Missile Configuration



The missile uses liquid hypergolic propellants for divert and attitude control. The booster is a single-stage solid propellant rocket motor with a flare. The flare consists of overlapping petals that lock into position after deployment. An inter-stage provides a physical interface linking the kill vehicle to the booster. The booster solid propellant is a hydroxyl-terminated polybutadiene composition that is rated as a Class 1.3 explosive. This booster rating includes the additional high-explosive energy associated with the flight termination system (FTS). The FTS is designed to terminate thrust if unsafe conditions develop during powered flight.

Mobile Launcher

The THAAD mobile launcher transports the interceptors in addition to providing a structure from which to fire them. The launcher consists of an easily reloadable missile round pallet. The pallet is an eight-round container with two tiers of four launch tubes. The launcher uses a modified M-1120 U.S. Army Heavy Expanded Mobility Tactical Truck-Load Handling System Truck to perform the functional requirements of the transporter on both improved and unimproved roads. The pallet can be quickly loaded onto or removed from the transporter using the truck.

THAAD Radar

The THAAD prototype radar is a wide-band, X-band, single faced, phased array radar system of modular design. The transmit/receive module has been upgraded to higher power outputs and improved reception levels. It performs surveillance, tracks the target, and controls firing functions. The radar communicates with the interceptor while it is in flight.

The THAAD radar consists of four units: Antenna Equipment Unit, Electronic Equipment Unit, Cooling Equipment Unit, and Prime Power Unit. The Antenna Equipment Unit includes all transmitter and beam steering components as well as power and cooling distribution systems. The Electronic Equipment Unit houses the signal and data processing equipment, operator workstations, and communications equipment. The Cooling Equipment Unit contains the fluid (ethylene glycol)-to-air heat exchangers, pumping system to cool the antenna array and power supplies. The Prime Power Unit, used to power the THAAD radar system, is a self-contained trailer in a noise-dampening shroud that contains a diesel generator, governor and associated controls, a diesel fuel tank, and air-cooled radiators. Each individual unit is housed on a separate trailer interconnected with power and signal cabling, as required. Operation of the Prime Power Unit would require refueling operations. The fuel tank of the Unit would be filled from a fuel truck as necessary.

C2BMC System

The basic C2BMC unit, the Tactical Support Group, consists of two tactical shelters mounted on XM-113 HMMVs; the Tactical Operations Station; and the Launcher Communications Station. There are also two HMMV cables and support equipment and towed tactical generators. The C2BMC system manages and integrates all THAAD components by providing instructions, processing sensor data, and communication with the radar and launcher. The C2BMC system also links the THAAD to other missile and air defense systems in the BMDS via the system-wide C2BMC. The C2BMC is connected internally and externally to allow the exchange of data and commands among the various components of the THAAD element. It uses a netted, distributed, and replicated flow of information to ensure uninterrupted execution of engagement operations. Key engagement operations include surveillance, threat evaluation, weapon assignment, engagement control, target engagement, and kill assessment. Missile launch procedures are controlled from separate C2BMC shelters mounted on XM-1113 High Mobility Multipurpose Wheeled Vehicles. Launch commands to the M-1120 Heavy Expanded Mobility Tactical Truck - Load Handling System Launcher are transmitted via fiber-optic cables.

Development

The THAAD element has been under development since the early 1990's. THAAD was formerly part of Theater Defense and is now an element of the Terminal Defense Segment. By the middle of FY 2000, THAAD had completed the Demonstration/Validation phase of its development. It is currently in the Systems Development phase.

THAAD has implemented a block approach. During Block 2004 THAAD program development will include the design and development of a significant, fundamental THAAD capability against short- and medium-range ballistic missiles. Development during Block 2004 aimed to reduce risk and to characterize component and element capabilities. Development activities include contractor conducted testing and modeling and simulations. The development program seeks to identify and correct failures at the lowest level possible and implement corrective actions early to support early design maturation, reduce risk, and control cost. For example, the THAAD prototype radar has been upgraded and has already undergone assembly, integration, and initial testing at WSMR. Verifying element capabilities supports THAAD integration into BMDS Block 2004 architecture.

Development plans for Block 2006 would include conducting THAAD system integration laboratory hardware-in-the-loop activities of hardware and software in preparation of flight-testing. Ongoing upgrades to the THAAD missile, radar, launcher and C2BM software would continue. Training programs would be conducted for staff planners and other Military Occupational Specialties.

Testing

Demonstration of the THAAD's capabilities during the 1990's was performed at WSMR, New Mexico where eleven flight tests were conducted in the Program Definition and Risk Reduction (PDRR) Phase. Upon successful completion of the PDRR, the THAAD program began planning a comprehensive test program to validate the performance capability and overall effectiveness of the THAAD element, to include flights tests, and intercepts of target missile launches over more realistic distances [50 to 3,000 kilometers (31 to 1,860 miles)] prior to its procurement and deployment. These distances are not available at WSMR; therefore, current testing plans for THAAD include missile launches and radar operation from PMRF on Kauai, Hawaii and from islands in the Republic of Marshall Islands. These ranges include short- (less than 482 kilometers), medium- (482 to 1,609 kilometers) and long-range (more than 1,609 kilometers) testing. Up to 50 THAAD interceptor missiles and up to 50 target missiles could be launched over a four-year period. This action was analyzed in the *Theater High Altitude Area Defense Pacific Test Flights Environmental Assessment* (U.S. Army Space and Missile Defense Command, 2002) and some of the activities proposed are summarized below. The

THAAD Development flight test program would consist of 17 contractor and government conducted flight tests and two radar data collection missions. These tests would be conducted in biannual blocks: Block 2004, Block 2006, and Block 2008.

Target missiles would be used to test the tracking and intercept ability of the THAAD components against realistic ballistic missile threats. Target missiles may carry payloads with biological or chemical simulants to test the effectiveness, or lethality, of the THAAD interceptor. These simulants are chemically and biologically neutral substances that mimic the significant qualities, such as dispersion, weight, and viscosity, of a toxic or hazardous substance that threat missiles could be armed with.

Testing - Block 2004

During Block 2004, testing would verify THAAD's capability against short- and medium-range ballistic missiles and would demonstrate its exoatmospheric and high endoatmospheric capability against unitary and separating targets in limited battle space. The Block 2004 flight test program would consist of four flight tests: one interceptor controls flight test; one system flight test employing a virtual target; one seeker characterization test; and one intercept flight test. The interceptor controls flight test would be conducted to confirm proper flight control operations in the high endo/exoatmospheric intercept regime. The seeker characterization flight test would ensure proper functioning of the interceptor's seeker in a live intercept environment. The remaining flight test would focus on demonstrating and characterization exoatmospheric performance capability, ultimately with soldier operation of the element. Demonstration activities at PMRF would begin in late FY 2006 and continue through FY 2010.

The Block 2004 THAAD element consists of an interceptor missile with range safety package (test missile), launcher, radar, and C2BMC. One or more THAAD missiles would be loaded in the missile round pallet. The remaining tubes would be filled with dummy missiles, which serve to balance the load across the breadth of the pallet. Operating radar and back up radar would be required. Some construction would be required at the selected radar site for a re-radiation tower that would verify the X-band communication link (transmit and receive) between the THAAD radar and the THAAD launch site. To operate the C2BMC, a Data Analysis Team would consist of 45 persons in two trailers. A Simulation Over Live Driver would generate simulated targets to add to live targets during flight tests. As of the publication date of the *Theater High Altitude Area Pacific Test Flights Environmental Assessment* (December 2002), specific support sensors and radars for each test had not been determined.

Solid propellant target missiles would be used to provide realistic threat scenarios. Target missiles would consist of a single reentry vehicle, a guidance and control unit, solid fuel boosters, and an aft skirt assembly. Solid rocket motors that could be used include the SR-19, GEM-40, Castor IV, Orbus-1, Polaris A3 and A3R, and the M-57A-1.

Testing - Block 2006

The Block 2006 flight test program would be conducted to demonstrate the endoatmospheric and exoatmospheric engagement capability. Block 2006 would consist of two radar data collection missions and 7 flight tests: an interceptor controls flight test, a seeker characterization flight test and 10 interceptor flight tests. The radar data collection missions would be non-interceptor (i.e., target only) flights using separating target missiles to gather data to support the development of radar software required later in the Block 2006 flight test program. The interceptor controls flight test would be conducted to confirm proper flight control operations in the endoatmospheric intercept regime. The seeker characterization flight test would ensure proper functioning of the interceptor's seeker in an endoatmospheric intercept environment.

Flight Test (FTT-06-5) would consist of two THAAD interceptors launched against a single target. All other Block 2006 flight tests would be single intercept missions (single interceptor, single target). Block 2006 flight-testing would resolve critical technical issues and critical operational suitability and effectiveness issues associated with the THAAD element design using the production representative missile configuration, C2BMC, and radar software upgrades.

Testing - Block 2008

Block 2008 flight testing will consist of six intercept missions. FTT-08-03 (14^{th} flight) will be a multiple, simultaneous engagement mission (two intercepts against two trailers). FTT-06-5 and FTT-08-6 would demonstrate expanded capability for THAAD to acquire and intercept threat-representative targets at higher velocities and longer ranges. The Block 2008 element will contain hardware and software improvements necessary to demonstrate launch on remote, remote launchers, and reporting of non-trajectory ballistic missiles. Future program upgrades would define deployability and survivability enhancements and expand THAAD element capabilities against faster and longer-range threats.

Testing - Block 2010

The technical details of Block 2010 are less defined than near-term block efforts. Block 2010 would focus on improving THAAD missile, radar, C2BMC and communications to better assimilate the element into the over all BMDS.

Some flight-testing that is scheduled to occur as part of the THAAD element development and demonstration also would be used to evaluate the overall interoperability of the BMDS.

Deployment

Deployment would include production, manufacture, and fielding of the THAAD element and any test-related assets. The THAAD element is designed to be a highly mobile interceptor weapon; therefore, fielding of the THAAD would include the transportation of the element components to designated locations and installation of component and support equipment. These locations have not yet been determined. Deployment would also include training of personnel to operate and perform ongoing operations and maintenance activities on the THAAD. MDA plans to deliver two THAAD Fire Units for operation by the Army in mid-FY 09 and mid-FY 11 timeframe. These two fire units will be stationed in existing THAAD motor pool facilities at Fort Bliss, Texas. Additional fire units and/or missile quantities for deployment will be determined based on Combatant Commander and Army requirements determination. Responsibility for operating and maintaining the THAAD will transition from MDA to the U.S. Army.

Decommissioning

Final ownership and disposition of permanent facilities constructed in support of THAAD testing would be determined by an inter-service agreement between the MDA and the host installation. Decommissioning would include the disposal of rocket propellant used in the THAAD booster. The THAAD's Class 1.3 propellant has a 20-year shelf life. Excess propellant would be recycled, burned or sold for re-use. A THAAD demilitarization plan will be developed for all THAAD components and will focus on re-use of equipment to the maximum extent possible.

NEPA Analysis

The following NEPA analyses support the majority of THAAD test and development efforts.

- *Ground-Based Radar Family of Radars Environmental Assessment*. June 1993. Analyzed TMD Ground Based Radars, which included the early versions of the THAAD radar.
- *Theater Missile Defense (TMD) Programmatic Life-Cycle Environmental Impact Statement*. September 1993. Provided conceptual coverage for all TMD activities.
- *Theater High Altitude Area Defense (THAAD) Initial Development Program Environmental Analysis*. March 1994. Analyzed the production of the THAAD missile at various plants in the United States, and the initial test flights at White Sands Missile Range (WSMR).
- *Environmental Assessment for Theater Missile Defense Ground-Based Radar Testing at Fort Devens, Massachusetts*. June 1994. Covered initial operational testing of THAAD Radar at Fort Devens, near the Raytheon Production Plant in Massachusetts.

- *Theater Missile Defense (TMD) Extended Test Range Environmental Impact Statement*. November 1994. Covered Th1D intercept launches from WSMR and target launches from Fort Wingate and Green River Launch Sites.
- *Theater Missile Defense (TMD) Flight Test Environmental Assessment*. April 1995. Covered test launches and intercepts at WSMR.
- *Theater Missile Defense (TMD) Flight Test Supplemental Environmental Assessment*. November 1995. Expanded the original number of launches and launch points that were covered in the TMD Flight Test EA.
- *THAAD Pacific Flight Test Environmental Assessment*. March 2003. Analyzed the launch of target missiles and THAAD intercepts at RTS, USAKA and PMRF.

D.7 Arrow Weapon System

Introduction

The Arrow Weapon System (AWS) is a ground-based missile defense system that is capable of tracking and destroying multiple targets during the terminal phase of their flight path. Development of the AWS is a cooperative effort between the U.S. and the Government of Israel to develop a missile defense system for the State of Israel. The AWS would defend Israel and U.S. and Allied forces deployed in the region from the evolving threats in the Middle East Region. The presence of a BMDS in Israel helps ensure U.S. freedom of action in future contingencies and would serve as a deterrent to aggression and proliferation of weapons in the Middle East.

The AWS consists of the Arrow II interceptor, the mobile launcher, the Fire Control Radar, the Fire Control Center, and the Launcher Control Center. The AWS is mobile and transportable.

The Arrow II interceptor missile is a two-staged vehicle launched from a six-pack mobile launcher. The missile contains solid rocket propellant with a hazard classification of 1.3 in the booster. The interceptor contains a focused blast fragmentation warhead to eliminate incoming missiles. The Arrow II interceptor is not hit-to-kill. It is controlled through aerodynamic and thrust vector control and contains a FTS. The Arrow II interceptor is capable of intercepting and destroying short- and medium-range ballistic missiles in the mid and high endo-atmosphere.

The fire control radar is L-Band phased array radar with search, acquisition, track, and fire control function configured in four vehicles (power, cooling, electronics, and antenna). The fire control radar is towable, using range-supplied vehicles on improved roads.

The fire control center is a mobile shelter in which all the battle management, command and control, communications, and intelligence functions are performed. It connects through multiple high-capacity communications interfaces to support communications with the fire control radar and other fire control centers.

The launcher control center is a mobile shelter that provides a communication interface between the fire control center and the Arrow Launcher. Its primary function is to enable monitoring of launcher and missile status and it also provides missile maintenance and diagnostic capabilities. The launcher control center can support operations at remote distances from the fire control center.

Diesel generators supply power to the AWS, with several smaller miscellaneous generators used for various support equipment. Nitrogen (N_2) tanks are kept at the launch control area, and N_2 gas is used to cool the onboard electro-optical sensor of the missile.

Development

The Arrow program was initiated in 1988. The first two phases were primarily focused on the development of the Arrow interceptor and launcher. In the third phase, integration and testing of other system components (launcher control center, fire control radar and fire control center) were accomplished. The latest phase of the Arrow program is the Arrow System Improvement Program (ASIP).

The purpose of the ASIP is to enhance the operational capabilities of the AWS to defeat emerging ballistic missile threats, including longer-range missiles and countermeasures. In addition, ASIP would enhance the capability of the AWS to interoperate with deployed U.S. missile defense systems. Technology development and data collection resulting from the ASIP would benefit both U.S. and Israeli missile defense efforts. As part of the ASIP, the current (baseline) AWS and the improved AWS would be tested in a series of flight tests in both the U.S. and Israel.

The ASIP consists of three phases. During the initial phase of the ASIP, technologies for insertion into the AWS were identified. The second phase of the ASIP consists of system development, in which the required component improvements would be designed, fabricated, tested and integrated into the total system. In addition, flight tests of the baseline AWS would be conducted in both the U.S. and Israel. The third phase of the program would focus on the testing and evaluation of the improvements implemented during the second phase.

Testing

All testing of the AWS before the ASIP was conducted in Israel. Because of the limited geography and airspace of the Israeli test range, the ASIP would include tests of the AWS in the U.S. to test the capability of the AWS to engage longer-range threats.

Flight tests of the AWS in the U.S. would consist of intercept flight tests at the Naval Air Warfare Center Weapons Division Point Mugu Sea Range against various short- and long-range threat representative target missiles launched from the surrounding test range open ocean area. Currently two series, or caravans, of tests are planned in the U.S. over a period of five years.

Caravan 1, completed in FY 2004, consisted of two flight tests necessary to the baseline AWS, including performance of critical subsystem and element level components,

against current threat-representative target missiles at realistic ranges. The primary objectives of Caravan 1 are to

- Perform baseline flight tests against current threats at full range, and
- Provide data to evaluate critical performance parameters.

Caravan 2 would consist of two flight tests of the enhanced AWS at Point Mugu against a threat-representative target at approximately full range. To the extent they are available, U.S. theater missile defense (TMD) elements or components would be used in interoperability testing and in data collection. The first flight test is planned to be an engagement of a Long Range Air-Launched Target configuration. The second flight test is planned to be a simultaneous engagement of an LRALT configuration and a Hera-based configuration at the maximum possible range allowed by test range constraints.

Deployment

The AWS system will be deployed in Israel and operated by the Israeli Air Force.

Decommissioning

The decommissioning of all or parts of the AWS element are dependent on many variables and the exact timing of any decommissioning activities has not been determined at this time. The decommissioning of AWS missiles and the demolition of element facilities (e.g., silos, radar buildings, etc.) would be in accordance with the applicable U.S. and Israeli environmental regulations and standard practices. The decommissioning effort would seek reuse and recycle materials to the maximum extent possible.

NEPA Analysis

The ASIP Environmental Aassessment (EA)/Finding of No Significant Impact was signed in November 2003. The ASIP EA analyzed the potential environmental consequences of the flight tests that are part of the ASIP that are scheduled to occur at a U.S. test range. The ASIP test program will include four missile intercept tests divided between two series, or caravans, of two tests each. The ASIP EA did not consider efforts being implemented in the State of Israel.

Other relevant NEPA analyses include

- *Development and Demonstration of the Long Range Air Launch Target System Environmental Assessment* (October 2002)
- *Point Mugu Sea Range Final Environmental Impact Statement /Overseas Environmental Impact Statement* (March 2002)

- *Theater Missile Defense Extended Test Range Supplemental Environmental Impact Statement– Eglin Gulf Test Range* (June 1998)
- *Air Drop Target System Program Programmatic Environmental Assessment* (May 1998)
- *Theater Ballistic Missile Targets Final Programmatic Environmental Assessment* (December 1997) *Theater Missile Defense Extended Test Range Environmental Impact Statement* (November 1994)

D.8 Medium Extended Air Defense System

Introduction

The Medium Extended Air Defense System (MEADS) program is an international cooperative development effort between the U.S., Germany, and Italy to develop a surface-to-air missile defense system that is strategically transportable and tactically mobile. MEADS will improve the limited area defense of vital assets, population centers, and deployed troops and will provide capability to move with and protect forces as they maneuver in combat. It will be capable of intercepting short- and medium-range threats including ballistic missiles in the terminal phase of their flight path and air breathing threats such as aircraft, unmanned aerial vehicles, and cruise missiles in the terminal phase of their flight path.

MEADS will incorporate the PAC-3 interceptor into a smaller, more self-sufficient missile defense system. Ground-based operations communicate with the missile before and during flight to guide the missile to the target. The PAC-3 interceptor is a hit-to-kill missile that uses active homing seeker to track and directly hit the target. A solid rocket motor propels the missile, and aerodynamic controls and an Attitude Control Section allow for the precision necessary for a direct hit. A lethality enhancer consisting of standard explosives can increase the probability of destroying the ballistic threat.

MEADS will be more tactically mobile than the PATRIOT element and therefore will be more capable of participating in combat maneuvers. MEADS will reduce strategic airlift requirements and therefore would be more easily transportable and readily deployable than the PATRIOT element. MEADS will have greater firepower and require less manpower than its predecessors. MEADS will also have greater lethality and improved capability against evolving threats in more stressing combat scenarios and is eventually expected to replace the PATRIOT system.

The components of MEADS will be linked by a flexible communications network with netted and distributed architecture enabling the MEADS units to be organized according to military strategy and expected threats. Within this network, battle management stations can hand over command and control of launchers and missiles to neighboring battle management units. The MEADS battle management units will share information from MEADS sensors and will have access to a broad range of sensors from other systems and services. The multiple paths of communication result in the system being very robust against jamming and also allow the units to be dispersed over a wide area. MEADS will be able to operate with the overall BMDS and other Army, joint, and allied systems. The international nature of MEADS increases the potential for the program to promote interoperability of U.S. and allied forces and to aid transatlantic defense

cooperation. The missile launchers can be located well away from the ground radar and the battle management units. This reduces the risk of detection of the launchers.

The MEADS Fire Unit will consist of six launchers and three reloaders, two Tactical Operations Centers, one Surveillance Radar, two Multi-Function Fire Control Radars, two armored security vehicles, and PAC-3 missiles. The MEADS fire unit will be mobile and C-130 roll-on/roll-off and C-160 transportable. The MEADS fire unit will also be CH-47 and CH-53 transportable.

The tactical operations center will perform the BMC4I functions of the MEADS Fire Unit. It will provide a single shelter for Engagement Operations/Force Operations and sensor and launcher control. A battle monitor will provide real-time link between engagement operations and force operations. The tactical operations center will have workspace for three operators. Each tactical operations center will be capable of serving as the battalion tactical operations center as well as the Fire Unit tactical operations center in a "multi-echelon configurability" approach.

The surveillance radar will employ Ultra-High Frequency Pulse Doppler Phased Array radar. It will be mounted on a truck and will provide 360-degree coverage. An onboard generator and transformer will provide power to each surveillance radar unit. The multi-function fire control radars will employ X-band Pulse Doppler Phased Array radar and will also provide 360-degree coverage. It will include a generator and transformer to provide power and will missile uplink/downlink software.

Development

The MEADS project will pass through three development phases, product definition/validation, design and development, and production. The participating countries will negotiate a Memorandum of Understanding for each of these phases.

MEADS is currently in the second stage, design and development.

The responsibility for MEADS was transferred from MDA to the U.S. Army at the same time as transfer of the PAC-3 element to the U.S. Army, in early 2003. The Army is responsible for the development, testing, budgeting, operations, fielding, and sustaining functions for MEADS. MDA remains involved from the BMDS perspective including BMDS performance, integration, and system testing.

Testing

Developmental testing will place emphasis on performance; integrated logistics support; reliability, availability, and maintainability; manpower and personnel integration; safety

verification; environment; survivability; interoperability; and live fire test – survivability and lethality

The U.S. proposed developmental testing will include 10 missions, 22 missiles, and 15 targets. Developmental testing will certify that the system is prepared for operational testing. The U.S. proposed operational testing will include three missions, 14 missiles, and seven targets.

Developmental Testing

Engineering development tests will be conducted during system development and demonstration to provide data on performance; safety; nuclear, biological, and chemical survivability; achievability of a system's critical technical parameters; refinement of hardware configurations; and determination of technical risks.

Operational Testing

Operational testing will consist of ground-to-ground testing, ground-to-air testing, FM simulation, digital simulations, and large search and track exercises.

Ground-to-ground testing will confirm proper functioning of ground equipment interfaces prior to conducting ground-to-air testing and flight tests. Ground-to-ground testing will use a Fire Unit along with a ground-to-ground test set to simulate the pre-launch communication activities and to "engage" a software-simulated target. The objectives of ground-to-ground testing include confirming the system baseline; verifying system software and hardware; and verifying radar and communication systems. Simulated faults will be inserted at various points in the launch sequence to test system contingency logic.

Ground-to-air testing will verify the integrated system and confirm missile and ground equipment interfaces prior to conducting flight tests. Ground-to-air testing will employ a Fire Unit to use an actual missile to engage an actual aircraft target (e.g., F-16 or MQM-107 Drone) or a simulated missile to engage a simulated Air-Breathing Threat. The objectives of ground-to-air testing include verifying radar and communications systems, verifying system hardware and software, verifying missile seeker target acquisition and target tracking functionality, and verifying system target handover and missile cueing.

FM Simulation will test the ability of the system to acquire, track, discriminate, and classify a threat target. The simulation will employ system sensors and computers in real-time scenarios. This simulation will evaluate the ability of the system to perform multiple simultaneous engagements. The simulation will assess the techniques, procedures, and tactics of the system. Large Search and Track Exercises will test sensors

in comprehensive and varied environments, including electronic countermeasures, low/high altitude, clutter, multi-path, and benign conditions.

Deployment

Full MEADS capability could reach the field as early as 2015.

Decommissioning

The decommissioning of all or parts of the MEADS element are dependent on many variables and the exact timing of any decommissioning activities has not been determined at this time. The decommissioning of MEADS missiles and the demolition of MEADS element facilities (e.g., silos, radar buildings, etc.) will be in accordance with the applicable environmental regulations and standard practices. The decommissioning effort would seek reuse and recycle materials to the maximum extent possible.

NEPA Analysis

Because the MEADS concept and technology are still in development, existing environmental analyses are limited.

- *Pacific Missile Range Facility Enhanced Capability Environmental Impact Statement* (December 1998)
- *PATRIOT Advanced Capability-3 (PAC-3) Life Cycle Environmental Assessment* (U.S. Army Space and Strategic Defense Command, May 1997)

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APPENDIX E
DESCRIPTIONS OF PROPOSED BMDS SENSORS

DESCRIPTIONS OF PROPOSED BMDS SENSORS

BMDS sensors comprise four sensor technologies (radar, infrared, optical, and laser) based on the frequency or electromagnetic (EM) energy spectrum involved. Sensors can be found on land, sea, air or space-based operating environments. Sensors planned for deployment as part of the proposed BMDS architecture have surveillance and tracking missions and may be stand-alone or part of individual weapons components. These sensors would be included in testing of the BMDS. However, some existing sensors are used solely for testing purposes and would not be used in a deployed BMDS.

There are two types of land-based radar that are currently components of the proposed BMDS: EWR and fire control radar. The EWRs are existing, fixed, land-based radars, which include the Position and Velocity Extraction Phased Array Warning System (PAVE PAWS), Ballistic Missile Early Warning System (BMEWS), COBRA DANE, and Advanced Research Project Agency Lincoln C-Band Observable Radar (ALCOR). Each of these radars already has a DoD mission to detect and track inter-continental ballistic missiles (ICBMs), submarine launched ballistic missiles, and satellite objects.

Fire control radar is used to provide target information inputs, such as providing continuous positional data to a weapon fire control system to support firing the weapon and guiding it to the target. Some fire control radars are multi-function and have early warning capabilities such as the PAC-3 radar. Land-based fire control radars may be fixed, located in or on a building, such as the GBR-P. Alternatively, they may be mobile, located on a vehicle or trailer, such as the PAC-3 radar.

The sea-based radars that are components of the proposed BMDS include the Aegis SPY-1 radar, the SBX, and mobile sensors placed on sea-based platforms.

Land-based infrared sensors would provide threat identification and location data to the proposed BMDS using the short and long wave infrared energy from the threat. Air-based infrared coverage for the proposed BMDS would be provided by the ABL. Space-based Infrared Sensors (SBIRs) include the DSP, SBIRS-High, and the planned Space Tracking and Surveillance System (STSS). These three systems are independent yet would complement each other by providing global infrared coverage. These systems support four mission areas: Missile Warning, Missile Defense, Technical Intelligence, and Battle Space Characterization.

Other BMDS sensors would operate in the visible light spectrum. Using data obtained from optical wavebands, the sensors would acquire and track threat ballistic missiles during all phases of flight. Laser sensors also would be used to track a target and focus a laser weapon on the target missile.

Sensor Descriptions

- **ABL -** The ABL has infrared and laser sensors mounted onboard an aircraft (a modified Boeing 747). These sensors include the ARS, TILL, and BILL. These are ANSI Classification 4 lasers; the BILL and TILL have a power output in the kilowatt range and the ARS is in the hundred watt range.

- **ARS -** The ARS laser operates at altitudes of greater than 10,668 meters (35,000 feet). It is a low power CO_2 laser that performs target acquisition and ranging for the ABL. The ABL ARS would be deployed as part of the BMDS architecture.

- **TILL -** The TILL is a lower power solid-state laser that uses a crystal as its lasing medium. The TILL is part of the laser beam control system and is designed to provide information on the target's speed, elevation, and vector. The TILL would be deployed as part of the BMDS architecture.

- **BILL -** The BILL is a lower power solid-state laser that uses a crystal as its lasing medium. The BILL is also part of the laser beam control system and is designed to focus the ABL weapon or HEL on the target and to correct for any atmospheric distortion.

- **IRST -** The IRST uses six infrared sensors to detect and track targets for the ABL. The IRST would be deployed as part of the BMDS architecture.

- **ALCOR -** ALCOR is a fixed, land-based system with wide-band radar that functions in the C-band. The ALCOR conducts long-range, high-power tracking. It would be deployed as part of the BMDS architecture.

- **Aegis SPY-1 Radar -** The U.S. Navy Aegis Weapons System is a multi-mission weapon system used on both Ticonderoga (CG-47)-class guided missile cruisers and on Arleigh Burke (DDG-51)-class guided missile destroyers. It is S-band multi-function phased array radar and is the primary air and surface sensor for the Aegis BMD. The SPY-1 replaces several conventional ship sensors, including long range search and fire control quality tracking radars. The SPY-1 radar has been modified to perform ballistic missile detection and tracking as part of its new capability as part of the BMDS. The SPY-1 radar is capable of collecting ballistic missile track data and would be integrated into the proposed BMDS through the C2BMC. The SPY-1 radar has four antenna arrays that send out beams of EM energy in all directions simultaneously. The SPY-1 radar can track many targets simultaneously. The SPY-1 radar would be deployed as part of the BMDS architecture.

- **Air Force Research Laboratory (AFRL) Ka-Band Radar -** The Air Force Cloud Profiling Radar system is Ka-band radar specifically designed for cloud microphysical

measurements. The system has the capability to provide characterizations of clouds and large atmospheric aerosols in terms of internal structure, geometric thickness, particle asymmetry, orientation, and relative motion. This radar would provide test data for the MDA Measurements Program.

- **AFRL Mobile Atmospheric Pollutant Mapper CO_2 Lidar -** The AFRL Space Vehicles Directorate's Mobile Atmospheric Pollutant Mapper CO_2 Light Detection and Ranging (Lidar) is a mobile trailer-based system. It employs a precision full hemispherical scanner. The Lidar's operating wavelength and transmitted beam size make it eye-safe at the exit aperture. This Lidar requires a 100-amp power supply and N_2, helium and CO_2 gases, approximately 60 liters (16 gallons) of liquid N_2, and approximately 76 liters (20 gallons) of distilled water.

- **AFRL Mobile Light Detection and Ranging Trailer -** This AFRL Lidar system is based in a Mobile Lidar Trailer which houses a steerable Lidar. The Lidar operates at three wavelengths making it highly sensitive. One of the signals can be used to spot the aerosol layers and direct other ground-based and airborne sensors when the plume is no longer visible. This mobile Lidar trailer requires a 30-amp power supply and is operated by the Battlespace Environment Division in the AFRL, Space Vehicles Directorate.

- **AN/FPS-16 -** AN/FPS-16 is a fixed, land-based system that functions in the C-band. It conducts close-range, high-precision tracking. The AN/FPS-16 would only be a test sensor.

- **AN/TPQ-18 -** AN/TPQ-18 is a fixed, land-based system that functions in the C-band. It conducts long-range, small-target tracking. The AN/TPQ-18 would only be a test sensor.

- **AN/MPS-36 -** AN/MPS-36 is a mobile, land-based system that functions in the C-band. It conducts close-range, high-precision tracking. The AN/MPS-36 would only be a test sensor.

- **AN/MPS-39 -** AN/MPS-39 is phased array radar that functions in the C-band. It is a multiple object tracking radar. The AN/MPS-39 would only be a test sensor.

- **ATR-500C -** Information is not available for this test sensor.

- **AN/FPQ-6 -** AN/FPQ-6 is a fixed, land-based system that functions in the C-band. It conducts long-range, small-target tracking. The AN/FPQ-6 would only be a test sensor.

- **Arrow Fire Control Radar -** The Arrow Fire Control Radar is part of the AWS. Specifically, the Arrow Fire Control Radar is L-band, mobile phased array radar with search, acquisition, track and fire control functions contained in four vehicles (power, cooling, electronics and antenna). This radar can be towed over the road. The Arrow Fire Control Radar is currently used by the nation of Israel and testing in the U.S. is proposed for the near future. It would be deployed as part of the BMDS architecture.

- **BMDS FDR -** The FDR is relocatable wide-band, phased array radar that operates in a portion of X-band spectrum. The radar uses the hardware/software design of the THAAD radar with addition of algorithms to support forward basing and software modules to enhance its ability to identify and track boost phase threats. This forward deployed radar will assemble data for tracking the threats and hand-over the threat tracks to the BMDS C2BMC element for control of intercept. (See Appendix D, THAAD and in this Appendix, TPS-X.) BMDS radar has the Antenna Equipment Unit, Electronic Equipment Unit, and Cooling Equipment Unit design from THAAD. The BMDS radar uses commercial power with a backup generator or a diesel generator(s), typical of those used for back-up power to industrial facilities, which requires routine refueling. The radar has an intrinsic capability to transition to a THAAD radar mission with the addition of the THAAD BMC2 and interceptor launchers. With the commonality of design and use, the NEPA analysis developed for THAAD radar is applicable to the BMDS radar. The TPS-X radar, also X-band, is an earlier demonstration design (hardware and software) of the THAAD radar and is a test bed for development and risk reduction of the FDR radar software and C2BMC connectivity.

- **BMEWS -** The BMEWS consists of Solid-State Phased-Array Radar System radars, which operate in the Ultra High Frequency range and would have the same mission as the PAVE PAWS in the proposed BMDS. The BMEWS radar network includes three sites; Clear Air Force Station, Alaska, Thule Air Base in Greenland; and Royal Air Force Air Base, Fylingdales, United Kingdom. The Clear and Thule BMEWS are two faced phased array radars, and the Fylingdales BMEWS is three-faced phased array radar. BMEWS tracks intercontinental ballistic missiles, short-range ballistic missiles, and earth orbiting satellites. The BMEWS would be part of the EWR system and would be deployed as part of the BMDS architecture.

- **COBRA DANE AN/FPS-108 -** The large L-band, computer-controlled, phased array radar system with local wide- and narrow-band communication systems, and an operations and test complex is located at Eareckson Air Station, Shemya, Alaska. It has historically fulfilled three concurrent missions: intelligence data collection of strategic missile systems; treaty verification; and early warning of ballistic missile attack against the continental U.S. and southern Canada. The system provides coverage that spans the eastern Russian peninsula and northern Pacific Ocean. It

would provide warning and target track information to the proposed BMDS. The COBRA DANE would be deployed as part of the BMDS architecture.

- **COBRA GEMINI -** COBRA GEMINI is a ship-based system that functions in the S-band and X-band. It performs detection, acquisition, tracking, and data collection on threat missiles and testing activities. COBRA GEMINI would be part of the BMDS and would be used during testing.

- **DSP -** The DSP is a system of satellites operated by the Air Force Space Command (AFSPC) that is a key part of North America's early warning systems and would be part of the proposed BMDS. In their more than 35,406 kilometer (22,000 mile) Geosynchronous Earth Orbits (GEO), DSP satellites help protect the U.S. and its allies by detecting missile launches, space launches and nuclear detonations. DSP satellites use an infrared sensor to detect heat from missile and booster plumes against the Earth’s background. In 1995, technological advancements were made to ground processing systems, enhancing detection capability of smaller missiles to provide improved warning of attack by short-range missiles against U.S. and allied forces overseas.

  The USAF has units that report warning information, via communications links, to the North American Aerospace Defense Command and U.S. Space Command early warning centers. These centers immediately forward data to various agencies and areas of operations around the world.

  Typically, DSP satellites are launched into GEO on a Titan IV booster. However, one DSP satellite was launched using the space shuttle on mission STS-44 (November 24, 1991).

  For more than 30 years, the DSP has provided integrated tactical warning attack assessment to the President and Secretary of Defense. For nearly 10 years DSP has provided theater commanders with similar missile warning notifications, first through the Attack Launch and Early Reporting to Theater system and most recently via the SBIRS Mission Control Station. Additionally, DSP host sensors provide nuclear detonation detection. Twenty-three DSP satellites have been built and all but two have been launched. The remaining inventory of satellites is scheduled for launch by 2005.

  A step toward a more robust infrared capability in space was taken with the declaration of the Mission Control Station at Buckley AFB, Colorado as operationally capable on December 18, 2001. The Mission Control Station consolidates command and control and data processing elements from dispersed legacy systems into a single modern peacetime facility. The Mission Control Station is also designed to

accommodate the new capability up through the SBIRS High constellation. The DSP would be deployed as part of the BMDS architecture.

- **GBR-P -** GBR-P is an X-band phased array radar located at RTS. The GBR-P phased array antenna face is mounted on a rotating assembly. It currently provides real-time operations as the GFC radar. GBR-P provides precision tracking, target discrimination, target-object-mapping and the kill assessment for the GMD and would be used similarly for the proposed BMDS. The radar system design leverages technology developed for the THAAD radar. Prior to commitment of interceptors, the GBR-P performs surveillance autonomously or as cued by other sensors, and will acquire, track, classify/identify and estimate trajectory parameters for target(s). In post-commit (after interceptor launch), the radar will discriminate and track the target(s), and provide an In-Flight Target Update and a Target Object Map to the GMD interceptor(s) (the in-flight EKV) via the In-Flight Interceptor Communications System. The GBR-P would be deployed as part of the BMDS architecture.

- **Homing All-the-Way-Killer X-Band Doppler Radar -** This radar was developed in the late 1950s as an anti-aircraft missile system. Among the original components was Doppler surveillance radar that operated in the X-band. The Homing All-the-Way Killer radar has been operated at WSMR to support the Aerial Dispersion Experiment tests (the release of 25 to 50 metal experiment objects). Power for the radar is supplied by a self-contained generator.

- **High Accuracy Instrumentation Radar (HAIR) -** The HAIR is a fixed, land-based system that operates in the C-band. It conducts long-range, small-target tracking. The HAIR would be a test sensor only.

- **High Altitude Observatory (HALO) -** The HALO-I is an airborne system housed in a modified Gulfstream IIB. It is an infrared imaging system with high-speed visible and infrared photodocumentation. The HALO-II is an airborne system housed in a modified Gulfstream IIB that operates at altitudes up to 13,716 meters (45,000 feet). It has visible and infrared photodocumentation and ultra high frequency satellite communication. It performs target acquisition and tracking. The HALO System would be test sensors only.

- **Innovative Science and Technology Experimentation Facility (ISTEF) -** The ISTEF is a research and development site that has designed a suite of transportable tracking mounts with variable range optics. The ISTEF mobile sensors use optics, passive sensors, and active (lasers) sensors to track missiles in the boost, midcourse and terminal flight segments. The ISTEF would be deployed as part of the BMDS architecture.

- **Infrared Sensor Simulator -** The Infrared Sensor Simulator is a Joint Installed System Test Facility sponsored by the Central Test and Evaluation Investment Program. The Navy is the lead for development of this system, which would be used to stimulate installed infrared and ultraviolet Electro-Optic sensors undergoing integrated developmental and operational testing. The simulator is a family of integrated software applications and hardware that would support all phases of the infrared simulation and test process. The Infrared Sensor Simulator would be specifically designed to support the design, development, integration, and testing of infrared electro-optic sensor systems. It would support testing of a sensor's installed/integrated functional performance and a sensor's performance characterization. The simulator would generate radiometrically correct scenes in real-time for reactive installed sensor-in-the-loop testing of a variety of infrared sensor systems. The generated scenes would provide a realistic portrayal of the infrared scene radiance as viewed by the unit under test in operational scenarios, and would be used for the direct (projected) and/or injected stimulation of the sensor.

- **Long Range Tracking and Instrumentation -** Long Range Tracking and Instrumentation is a fixed, land-based system that operates in the X-band. It is used for detecting, tracking, and imaging targets and interceptors. Long Range Tracking and Instrumentation would be a test sensor only.

- **Maui Space Surveillance System (MSSS) -** The MSSS is located on the summit of 3,048-meter (10,000-foot) Mount Haleakala on the island of Maui, Hawaii. The MSSS is a space surveillance and Research and Development site. The Air Force Maui Optical and Supercomputing (AMOS) detachment of the AFRL operates the MSSS, a national resource providing measurement support to various government agencies and the scientific community. One of the objectives of the AMOS program is to serve as a test bed for newly developed, evolving electro-optical sensors. The Maui Space Surveillance Complex consists of two facilities, the MSSS and the Ground-based Electro-Optical Deep Space Surveillance system. The MSSS is a state-of-the-art electro-optical facility that provides primary space surveillance coverage and high accuracy trajectory information. The MSSS has two telescopes with infrared sensors, the long-wave infrared sensor on the 3.6-meter (12-foot) telescope and the GEMINI sensor on the 1.6-meter (5-foot) telescope. The MSSS would be used in the proposed BMDS as a test and development support sensor. Specifically, the telescopes would observe MDA test activities and provide images for post-test analysis. The infrared sensors would be used for operations and research on tracking and imaging space objects for the proposed BMDS. The suite of passive and active sensors at MSSS AMOS would conduct mid-course target tracking and satellite tracking and would be deployed as part of the BMDS architecture.

- **MEADS Surveillance Radar -** The MEADS radar is being developed as mobile, land-based radar that will be a part of the MEADS system. It will function in the

X-band ultra high frequency with rotating, Pulse Doppler phased array radar. It will perform surveillance, tracking and fire control. The MEADS radar would be deployed as part of the BMDS architecture.

- **Midcourse Space Experiment (MSX) -** The MSX is a space-based system that uses eleven optical sensors functioning in the low wavelength infrared to ultraviolet range to detect, track and discriminate targets. The MSX would be used during testing only.

- **Millimeter Wave Radar -** The Millimeter Wave radar is a fixed, land-based system that functions in the Ku-band and W-band. It performs imaging and tracking of targets and interceptors. This radar would be used during testing only.

- **Naval Surface Warfare Center -** The Naval Surface Warfare Center has a suite of fixed and mobile infrared and optical sensors with air-, land-, and sea-based capabilities. The Naval Surface Warfare Center sensors would perform target tracking during testing only.

- **PATRIOT Radar (AN/MPQ-53 [AN/MPQ-65 upgrade]) -** The PATRIOT radar is a mobile system consisting of AN/MPQ-53 C-band multifunction phased array radar mounted on a semi-trailer towed by a Heavy Expanded Mobility Tactical Truck. The PATRIOT radar is the primary mission sensor for the PATRIOT system and performs surveillance, target tracking and controls firing functions. It is a single faced, non-rotating, phased array radar that provides targeting and tracking information to the Engagement Control Station (i.e., the PATRIOT Battle Management/Command, Control and Communications [BMC3]) throughout PATRIOT defensive operations, and particularly during PATRIOT missile flight and intercept. The AN/MPQ-65 is an upgrade to the AN/MPQ-53 (both will be part of the Block 2004 IDO Capability). An Electrical Power Plant powers the Radar Station. The Radar Station has a personnel exclusion area established 120 meters (395 feet) to the front, and extending 60 degrees to each side of the center of the radar during radar operations. The PATRIOT radar is currently used at various military installations worldwide. The radar would be deployed as part of the BMDS architecture.

- **PAVE PAWS -** PAVE PAWS is a solid-state phased array radar system, designated AN/FPS-115. Each of the PAVE PAWS radars is housed in a 32-meter (105-foot) high building with three sides. Two sides of the building house the flat phased array antenna faces, each containing approximately 1,800 individual active radiating antenna elements that transmit and receive radiofrequency signals generated by the radar. Besides detecting and tracking inter-continental and submarine launched ballistic missiles, the system also has a secondary mission to detect and track Earth-orbiting satellites. Information received from the PAVE PAWS radar systems is forwarded to the U.S. Space Command's Missile Warning and Space Control Centers at Cheyenne Mountain AFB, Colorado. Data are also sent to the National Military

Command Center and the U.S. Strategic Command. Currently the PAVE PAWS network includes two solid-state phased array radar systems located at Cape Cod Air Force Station, Massachusetts and Beale AFB, California. The PAVE PAWS would be deployed as part of the BMDS architecture.

- **SBX -**The SBX would consist of a sea-based platform or commercial oil-drilling platform modified to support XBR. The platform would be an existing, commercial column-stabilized semi-submersible platform with two pontoons and six stabilizing columns supporting the upper hull. Communication systems and an IDT would be mounted on opposite sides of the platform. The XBR, which would be mounted on top of the platform, is multifunction radar that would perform tracking, discrimination, and kill assessments of over flying target missiles. The XBR would use high frequency and advanced radar signal processing technology to improve target resolution, which permits the radar to discriminate against various threats. The XBR would provide data from the midcourse phase of a target/threat missile's trajectory and real-time in-flight tracking data. The data would be transmitted using radio and military satellite communications and potentially though a connection to a fiber optic transmission line. The initial operations for the SBX are planned for the Pacific Ocean region and the Primary Support Base for the SBX is Adak, Alaska. The SBX would be deployed as part of the BMDS architecture.

- **STSS -** The STSS was previously called the SBIRS Low program. Through its spiral development process, STSS would provide space-based infrared capability to acquire, track and discriminate ballistic missiles and supply over-the-horizon fire control to BMDS weapon systems extending their effective range. The near term emphasis for STSS is on tracking performance, followed by improvements in the sensor's discrimination capability. Using the advantage of a lower operational altitude, the STSS would track tactical and strategic ballistic missiles. The satellite's sensors would operate in Low Earth Orbit (LEO) across long and short wave infrared frequencies to acquire and track missiles in the boost phase of flight. By combining information collected by infrared and optical sensors, STSS satellites would substantially improve the performance of BMDs for the boost and midcourse phases of flight. The STSS is expected to launch its first satellites in 2007. The STSS would be deployed as part of the BMDS architecture.

- **SBIRS High -** SBIRS High features a mix of four GEO satellites, two highly elliptical Earth orbit payloads, and associated ground hardware and software. These satellites would use infrared sensors to detect heat from missile and booster plumes. SBIRS High would have both improved sensor flexibility and sensitivity. Sensors would cover short-wave IR, expanded mid-wave IR and see-to-the-ground bands allowing it to perform a broader set of missions as compared to DSP. SBIRS High is a USAF program that would eventually replace the DSP. The SBIRS High would be deployed as part of the BMDS architecture.

- **THAAD Radar -** The THAAD radar is part of the THAAD system. It is a mobile, land-based system with a wideband, X-band, single faced, phased array radar. The radar performs detection, target discrimination, tracking, and kill assessment. The THAAD radar would be deployed as part of the BMDS architecture.

- **TPS-X -** The TPS-X radar is a relocatable wide-band, X-band phased array radar system of modular design. The TPS-X is the User Operational Evaluation System THAAD radar now being used as the test bed for the BMDS FDR. As single faced, non-rotating, phased array radar it performs surveillance, tracks the target and will transmit data used by C2BMC for controlling firing functions. TPS-X consists of three units: Antenna Equipment Unit, Electronic Equipment Unit, and Cooling Equipment Unit. The Antenna Equipment Unit includes all transmitter and beam steering components as well as power and cooling distribution systems. The Electronic Equipment Unit houses the signal and data processing equipment, operator workstations and communications equipment. The Cooling Equipment Unit contains the fluid-to-air heat exchangers and pumping system to cool the antenna array and power supplies. The power can be provided by either a commercial line or by a diesel generator(s), typical of those used for back-up power to industrial facilities and requires routine refueling. Each individual unit is housed on a separate trailer interconnected with power and signal cabling, as required. The fuel tank of the generator would be filled from a fuel truck as necessary.

- **Tracking and Discrimination Experiment Radar -** This radar is a fixed, land-based system that functions in the S-band with L-band capabilities. It performs target tracking and discrimination. The tracking and discrimination experiment radar would only be a test sensor.

- **Transportable Telemetry System (TTS) -** The TTS is a long-range, high data rate telemetry collection, processing, and data transmission system. Its primary mission area is midcourse and terminal phase telemetry coverage. The TTS is a standalone system capable of supporting flight tests from remote areas with minimal or no test infrastructure. The TTS can receive and record multiple telemetry streams with redundancy in the S- and L-bands. The TTS would have the capability to process multiple streams in real-time. Over-the-horizon voice and data communications would be provided through a built-in satellite communications system. Each TTS would have a satellite uplink/downlink terminal. The system configuration would consist of two primary telemetry shelters, two 7-meter (23-foot) antennas, two power shelters, and a SATCOM antenna and shelter. The TTS would be powered by two 100 kilowatt generators, or via a shore power from fixed power lines. Approximately 625 square meters (25 by 25 meters) would be required to set up the mobile TTS. The transportation of the TTS would require either four tractor-trailers or two C-130 or similar aircraft.

- **U.S. Naval System (USNS) Observation Island -** The USNS Observation Island is a ship-based, phased array radar system. The USNS Observation Island radar systems are a national system for technical verification of foreign ballistic missile reentry systems. The instrumentation consists of the world's largest ship-borne phased array radar, parabolic dish-type radar, and a telemetry system. The USNS Observation Island includes S-band and XBRs, which would be used to verify treaty compliance and provide support to missile development tests by the MDA. The radars would also be used for research and development work in areas not accessible to ground-based sensors. The Military Sealift Command is responsible for operating the mobile platform, while the USAF is responsible for operating the radar systems and administrative support. USNS Observation Island would be deployed as part of the BMDS architecture.

- **W-Band Tornado Radar -** The W-band Tornado radar is a polarmetric, pulsed Doppler radar. It has a dish antenna and is mobile. The antenna is mounted on a crew-cab pickup truck. For power this radar uses a 3,500-watt generator, mounted on the tail hitch of the truck. The radar runs on 110-volt alternating current and has a 15-amp maximum current. The radar is jointly operated by the Universities of Massachusetts and Oklahoma.

- **Widebody Airborne Sensor Platform (WASP) -** The WASP is an airborne system housed in a modified DC-10. It has ultra high frequency satellite communication and performs target acquisition and tracking. The WASP would be only a test sensor.

APPENDIX F
ADVANCED SYSTEMS

ADVANCED SYSTEMS

Introduction

The MDA Advanced Systems program develops and transitions science and technology hardware and software programs into BMDS elements. New concepts are inserted by MDA and external participants, including industry, research facilities, and foreign governments. New concepts and technologies undergo an initial review that includes

- Assessment of BMDS utility,
- Assessment of technology maturity - expected technology development progress, defined utilizing Technology Readiness Levels, and
- Assignment of transition targets - users of the technology are identified and liaison takes place to develop a transition plan to the appropriate elements.

Upon completion of this initial review, the concepts and developing technologies enter a continuous process that evaluates the technology's development process, BMDS utility, and transition prospects. Advanced Systems monitors the technology maturation and assesses the technology at regular intervals. Promising and mature technologies are transferred to one or more BMDS elements. The sections below summarize current Advances Systems programs.

Project Hercules

The objective of Project Hercules is to develop algorithms that increase BMDS capability to counter the full spectrum of potential threats. Project Hercules is developing a communications structure that would pass data during flight tests. Project Hercules works with BMDS Elements, Prime Contractors, and System Engineers to identify potential algorithmic areas of improvement. Project Hercules also looks for long-term promising algorithm methodologies.

Advanced Concepts Analysis Group

The Advanced Concepts Analysis Group conducts short- and long-term studies of promising concepts and technologies for future block upgrades.

Small Business Innovation Research Program

The Small Business Innovation Research Program works to stimulate technological innovation, meet research and development needs of the MDA, foster opportunities for small businesses, and support commercialization of technology.

Terminal Missile Defense

Long Range Atmospheric Defense (LRAD)

The goal of LRAD is to develop a long-range, high endoatmospheric interceptor that can engage intercontinental ballistic missile threats in the terminal phase of flight. LRAD would provide a backstop for midcourse tier leakage and would hedge against technological surprise in adversaries' countermeasure capability elements including any attempt to fly under existing defense architectures. LRAD would enhance the effectiveness of the multi-tier system and provide total United States terminal defense coverage with a small number of defense units.

LRAD is currently in the Concept Definition Phase and is based on using atmospheric interaction with the threat cloud as the key metric for discrimination of the lethal object(s). A number of revolutionary technology advancements have been evaluated indicating the most promising set for development including an approved development plan. Execution of this LRAD development plan will yield component demonstration and concept down select for an eventual proof-of-principle prototype integrated flight test of the LRAD interceptor. The goal is to provide a new LRAD element fully integrated into the BMDS 2015 - 2020 architecture.

Midcourse Missile Defense

Discriminating Seeker

A Discriminating Seeker would be developed that is able to accurately discriminate emerging countermeasures, decoys, and re-entry vehicles. The technologies under development are multi-spectral infrared focal plane arrays, ultra compact laser radar (ladar), high-speed miniature processors, and data fusion algorithms. These components would be integrated into a lightweight Track-Via-Missile seeker after development and demonstration.

At greater distances (400 to 800 kilometers [249 to 497 miles]), the focal plan arrays would acquire the target cluster and perform simple discriminations. At shorter distances (less than 400 kilometers [249 miles]) the focal plan arrays and ladar would work together to accurately discriminate and track the target. The multi-spectral infrared focal plane arrays can accurately measure thermal characteristics of non-gray-body re-entry vehicles and decoys. Ladar actively illuminate the target with a laser and measures back-scattered Doppler-shifted radiation to calculate target range, velocity, and angular rates. Ladar does not rely on external illumination or emitted radiation from the target. Ladar substantially increases the number of target features measurable and significantly improves discrimination and aim point selection. Ladar could be applied to early

deployment phase to track threat cloud dispersal. Ladar would assist in boost phase functions of hard body/plume discrimination and final aim-point selection.

After development and testing of the individual technology components of the seeker, the components would be integrated into a lightweight Track-Via-Missile seeker.

Advanced Discrimination Initiative

The Advanced Discrimination Initiative would investigate and develop interceptor payloads that move beyond the current hit-to-kill Kill Vehicle payloads. The Advanced Discrimination Initiative would validate these advanced interceptor payload concepts and understand how they would generate into the BMDS block plans. This initiative is a cross-Agency effort to modify BMDS weapons and sensors to defeat adversary countermeasures.

Multiple Kill Vehicles

The Multiple Kill Vehicles program aims to develop small, lightweight, and lethal kill vehicles dispensed from a single booster. The integrated payload would be designed to fit on existing and future interceptor boosters. One or more Multiple Kill Vehicles can be assigned to intercept all credible targets within a threat cluster when discrimination is challenging. Multiple Kill Vehicles have the potential to solve many of the most difficult countermeasure challenges.

The Multiple Kill Vehicles program will demonstrate the feasibility and lethality of Multiple Kill Vehicles through conceptual designs, analyses, simulations, and flight testing and critical hardware demonstrations. Existing and emerging miniaturization technology would be evaluated and subsequently integrated into a functional system.

Boost Missile Defense

Early Launch Detection and Tracking

The Early Launch Detection and Tracking program would develop and demonstrate all-weather surveillance techniques that detect, track, and classify ballistic missile threats as soon as possible after liftoff with very high confidence and low false alarm rates. The program is analyzing, developing, integrating, and testing several sensor technologies that may provide detection of boosting threats significantly earlier than currently available sensors. Both active and passive sensors using optical and radio frequency band concepts are being evaluated.

Pumped Propulsion

The Pumped Propulsion program aims to develop a lightweight, high mass fraction kill vehicle divert and attitude control system utilizing non-toxic propellants. Boost phase interceptors must have the ability to quickly accelerate and catch the target. A low mass, high mass-fraction, kill vehicle divert and attitude control system would enhance boost phase interceptor capability. Pumped propulsion has traditionally been used in large launch vehicles; however, several challenges exist in applying pumped propulsion to light weight boost interceptors.

Global Defense

Space-Based Passive Surveillance

The goal of the Space-Based Passive Surveillance program is to extend the wavelength response into the very-long wavelength of electro-optical component technologies, in order to enable the detection and tracking of distant exoatmospheric targets, thereby improving exo-intercept capability. Space-based Passive Surveillance technology development efforts would include advanced Focal Plane Arrays, optical elements, cryocoolers and radiation-hardened electronics – technologies that can be used by the STSS system.

High Altitude Airship (HAA)

The HAA would be a mobile, unmanned and untethered airship that can be deployed worldwide as a stable, geo-stationary communications, sensors, and weapons platform. The HAA would be able to operate autonomously in long-endurance operations of more than one year. The HAA would operate at 21,336 meters (70,000 feet) above mean sea level (MSL) where wind conditions are minimal and the HAA would have a large field of view. The HAA would be used in homeland defense and theater operations for missile defense and military communications. The HAA would help overcome the challenge of detecting and countering low-flying and maritime threats, especially cruise missiles. The HAA would be able to broadcast and relay communications. Command and control of the airship would be from a fixed ground location in Colorado Springs. Compared to satellites, a fleet of HAAs would have lower costs and simplified battle management with reduced timelines. Currently, a fleet of 12 HAAs is envisioned to enhance national security and improve missile defense capabilities.

The HAA would contain helium to make it a “lighter-than-air” technology, thereby saving energy and reducing emissions. The HAA would be built from strong, lightweight, and durable materials. The HAA vehicle would be 152 meters (500 feet) long and 46 meters (150 feet) wide. Photovoltaic cells and fuel cells would power the HAA. Electric-powered propeller technology would be used to propel the HAA and

maintain geo-stationary location. The HAA would be able to carry a minimum payload of approximately 1,800 kilograms (4,000 pounds) and would be able to deliver at least 75 kilowatts to the payload.

The airship vehicle and subsystems, along with system integration interfaces and control systems, would be sufficiently developed, tested, and integrated to meet mission requirements. Strong, durable materials, lightweight renewable energy sources, and propeller technologies would have to be developed and improved to make the HAA technically feasible. Components and subsystems would be tested prior to integration, and the integrated system would undergo ground testing and flight-testing.

The HAA Advanced Concept Technology Demonstration is to develop a prototype HAA in order to demonstrate the feasibility and utility of the HAA concept. The prototype HAA would be an unmanned, untethered airship that would operate autonomously for one month at a geo-stationary location 18,288 to 21,336 meters (60,000 to 70,000 feet) above MSL with a payload of 1,814 kilograms (4,000 pounds). The prototype HAA would be able to deliver 15 kilowatts (kW) of power. The demonstration would test the technical readiness of all necessary technologies, materials, aerodynamics, flight control, and internal environment management. It would also test the launch, flight, and recovery capabilities. Based on the demonstration results, the operational concepts would be validated and refined.

Enabling Technology

Radar Technology

Emerging component technologies would allow for radar systems that have increased sensitivity and longer ranges, lower elevation angles, and increased discrimination capability. The technologies would allow radar systems to be more effective against enemy countermeasures. The radar systems would have increased transportability and reduced costs.

Laser Technology Program

The objective of the Laser Technology Program is to pursue laser technologies on a broad front across multiple functions of boost, midcourse, and terminal phase defense tiers. This program will select laser projects that significantly support BMDS block upgrades or lead to entirely new defense system capabilities while generally excluding laser communications, processors, and basic research projects.

The Laser Technology Program is designed to support significant improvements to execute BMD functions and to add new capabilities to BMDS components. Low power solid-state laser technology supports improvements in optical sensor angle and range

resolution and precision tracking, target discrimination, and kinetic energy weapon guidance. Low- and medium-power lasers can provide improved target imaging and long-range acquisition and tracking, while medium and high-power lasers can contribute to advanced discrimination and kill assessment. Improvements in high power chemical lasers can significantly enhance the potential effectiveness of future laser weapon systems. The Laser Technology Program includes the following projects: Strategic Illuminator Laser, Advanced Inertial Reference Unit, Advanced Detectors for Ladar, and Small Laser Amplifier for Ladar.

Multi-Application Focal Plane Arrays

Development of focal plane arrays technology, including simultaneous, high sensitivity dual-band (Medium Wavelength Infrared and Long Wavelength Infrared) focal plane arrays would allow for increased range and sensitivity for detecting targets. Development would emphasize continuous tracking over boost to post-boost phases. Increased sensitivity would enable detection by miniature interceptors of targets in the boost or in post boost phases. Higher frame rates would enable acquisition and tracking of targets at high approach speeds. Higher frame rates would also allow for tracking of error signals. Focal plane arrays would be inserted into a camera system and tested to characterize performance. Testing would include data collection in the laboratory and acquisition and tracking of target launch and flight in boost and post-boost phases. Focal plane arrays would enhance ABL and KEI capabilities.

Spectral Imaging

Spectral Imaging may be utilized in BMDS sensors because it provides a broader and more comprehensive view of material properties, availability of more regions to target for improved discrimination, and can be tailored to a variety of applications. Spectral Imaging may be used to track and discriminate target objects within all phases of missile flight and kill assessment by providing characteristic infrared spectral fingerprints for all objects in a scene of interest. The Spectral Imaging program would identify useful spectral signatures that are characteristic of targets and countermeasures. Spectral Imaging provides more accurate temperature estimation than current sensors. Advances in miniature spectral sensors with lower cost and reduced mass and volume increase the utility of spectral sensors to the BMDS. Spectral Imaging is in an advanced stage of development as a stand-alone measurement tool, however, spectral sensors must be adapted to specific BMDS elements and platforms, and supporting algorithms must be customized to specific signatures.

Joint Industry Programs for Technology

The Joint Industries Programs for Technology includes three programs

- Technology Applications Program,
- Commercial Technology Exploitation Initiative, and
- Joint Technology Development with Industry Program.

The Technology Applications Program seeks to identify commercial applications for technology developed by MDA. The objectives of this program are to reduce final product cost through economies of scale and to assure maturation of the technology. The Commercial Technology Exploitation Initiative seeks to identify non-defense commercial technologies that are either currently available or in the final stages of development and can potentially contribute to MDA systems. Commercial technologies may satisfy the needs of BMDS elements with lower costs, increased performance, and shorter development timelines. The Joint Technology Development with Industry creates a team effort between MDA, the program elements, and industry to understand common development needs, maximize technology development resources, and reduce development costs through shared efforts.

Innovative Science and Technology

The Innovative Science and Technology (ISTEF) program invests seed money in selected applied and exploratory research and development high-risk technologies relevant to missile defense. The ISTEF program interacts with Universities and the research community, identifies research and development breakthroughs as they arise, and works with researchers to develop novel technologies for the BMDS.

The program is currently pursuing several research and development efforts. The Optical Target Characterization ISTEF aims to further the understanding of target observables and associated sensing instrumentation, procedures, and signal processing. The Dual-Mode Experimentation on Bowshock Interaction Flight Experiment would further the understanding of chemistry associated with hypersonic flight in hit-to-kill applications within the Earth's atmosphere. The ISTEF program would develop and demonstrate stability of holographic glass with the capability to enhance high power laser beams and optical sensors. The ISTEF program would develop polymeric photonic devises and demonstrate their utility for discrimination and identification during boost and midcourse phase, and for assisting track-via-missile seekers during the discrimination process. The ISTEF program would also develop and demonstrate polymer-based modulators for novel control schemes of phased array radars.

International

The MDA International Program aims to identify technologies being developed in other countries that surpass, complement, or represent a viable alternative to those available through United States supplies. The program fosters and cultivates relationships with friends and allies and their scientific communities. MDA exchanges ideas and perspectives on missile defense and promotes international support.

The MDA cooperates with officials and scientists of the United Kingdom and Germany to investigate, test, and develop technologies that are of mutual interest and can contribute to missile defense. The MDA funds researchers in Israel to research and improve missile guidance against maneuvering targets. The MDA funds researchers in the Czech Republic to develop focal plane arrays for infrared detector technology. The MDA funds researchers in Hungary to investigate the use of cellular nonlinear network image processing to perform target detection and classification and sensor fusion. The MDA funds researchers in Russia to investigate the synthesis of high energy materials for propulsion and explosives. MDA awards research grants to foreign research facilities and sponsors travel to the U.S. as a means to facilitate exchange of technical information among scientists.

Other

Tactical HEL

A Tactical HEL could be used to counter short-range missiles, rockets, and other air threats. The U.S. is assisting Israel in developing a mobile, tactical-sized laser to defend Israel's northern cities from short-range threats. Testing of a laser demonstrator began in 2000.

Satellite-Based Laser Communications

Satellite-Based Laser Communications would allow for more efficient and rapid transmission of large amounts of information.

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APPENDIX G
APPLICABLE LEGAL REQUIREMENTS

APPLICABLE LEGAL REQUIREMENTS

This appendix provides an overview of the applicable federal statutes enacted by Congress; corresponding regulations promulgated by the Federal agency charged with implementing the statute; EOs signed by the President of the U.S. and directed to Federal agencies; internal orders, directives[11], and policies implemented by the Federal agencies; and international treaties and convention to which the U.S. is a party. This overview is not exhaustive, as it does not include all possibly applicable legal requirements, further, all of the listed requirements may not be relevant to every activity associated with the proposed BMDS. Therefore, site-specific environmental documentation may require a more thorough investigation into the specific Federal and international legal requirements. Likewise, local laws and regulations are excluded and should be addressed in site-specific environmental documentation. With the exception of requirements that apply generally to the MDA or to the BMDS PEIS, and those that apply to orbital debris, the legal requirements in this appendix are organized by Resource Area. Where appropriate, applicable Federal and international requirements are specified by Resource Area.

Generally Applicable

Missile Defense Act (Public Law 92-190), enacted as part of the National Defense Authorization Act of 1992, establishes goals for theater and national missile defenses (NMDs). It directs the DoD to develop a TMD system for possible deployment at an initial Anti-Ballistic Missile Treaty-compliant site by 1996 or as soon as appropriate technology would allow. In July 1992, Secretary of Defense Cheney outlined a plan for the development and deployment of theater and national missile defenses. In passing the National Defense Authorization Act (Public Law 92-484) of 1993, Congress deleted the dates contained in the Act and in the conference report accompanying this Act. Congress endorsed a plan to deploy a limited national missile defense system by 2002.

NMD Act of 1999 (Public Law 106-38), states that "[i]t is the policy of the United States to deploy as soon as is technologically possible an effective NMD system..."

The Treaty between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms Treaty (START) is a treaty that provides for reductions in U.S. and Soviet strategic offensive nuclear forces. START I is a protocol between the U.S. and Russia, Belarus, Kazakhstan, and Ukraine and is recognized for its complexity and comprehensive approach. START II was signed by the U.S. and Russia after the demise of the Soviet Union and calls for

[11] DoD Services may have their own policies that apply to various resource areas. For example, the U.S. Army recently developed Army Regulation 200-4: Cultural Resources Management (AR 200-4), which is an official policy for management, care and preservation of cultural resources. Policies specific to DoD services are not addressed in this PEIS and should be considered as part of site-specific environmental analyses.

further reductions in nuclear arsenals (by approximately two-thirds) and prohibits the use of ICBMs.

NEPA of 1969, as amended (42 United States Code [U.S.C.] 4321), requires federal agencies, early in the agency's planning process, to assess the potential environmental impacts of implementing major federal actions so that this information can be used in the decision-making process. The Act requires analysis of effects from the full range of project alternatives, along with public comment and review. NEPA specifies several levels of environmental review, ranging from Categorical Exclusion for categories of actions that have been determined to not have a substantial effect on the environment, to EISs for major, unprecedented, or controversial actions having potentially significant environmental impacts. NEPA is implemented through CEQ regulations at 40 CFR Parts 1500-1508.

Regulations developed by the CEQ (40 CFR Part 1500) define the procedures for completing the environmental review and analysis called for in NEPA. The regulations outline the principles to be followed in the environmental impact analysis process, including incorporating environmental review early in project planning, preparing an action-forcing environmental document to assist in project decisions rather than one that documents decisions previously made, and ensuring public involvement throughout the process. The regulations also include guidelines for determining what level of environmental review is required; the contents of environmental documents; procedures for comments by the public and federal agencies; and schedules.

In accordance with the CEQ regulations for implementing NEPA (40 CFR 1507.3(b)), the DoD and the military services have developed regulations that further implement NEPA within the Department. These regulations establish categorical exclusions for those actions, which do not individually or cumulatively have a significant effect on the human environment (see Exhibit G-1). Where appropriate, the DoD and the military services have established categorical exclusions for such activities. For example, infrequent, temporary (less than 30 days) increases in air operations up to 50 percent of the typical installation aircraft operation rate are categorically excluded.

Exhibit G-1. Location of Categorical Exclusions in Agency or Service NEPA Implementing Regulations

DoD Entity	NEPA Implementing Regulations
Department of Defense (DoD)	32 CFR, Part 188
Department of the Army	32 CFR, Parts 650, and 651
Department of the Navy	32 CFR, Part 775
Department of the Air Force	32 CFR, Part 989
Department of the Army, U.S. Army Corps of Engineers	33 CFR, Part 230

EO 13148, Greening the Government Through Leadership in Environmental Management (65 FR 24595 (2000)), requires Federal agencies to develop a plan to phase out the procurement of Class I ozone-depleting substances for all nonexcepted uses by December 31, 2010. Plans should target cost effective reduction of environmental risk by phasing out Class I ozone depleting substance applications as the equipment using those substances reaches its expected service life.

International Framework

Some MDA activities may occur outside the continental U.S. (OCONUS), its territories and possessions. Because NEPA and other environmental laws do not generally apply to OCONUS activities, various EOs and DoD directions have been implemented. This section describes the framework within which MDA activities must comply regarding these international activities.

- **Overseas Environmental Planning Issues**. Because the NEPA does not apply to overseas actions, EO 12114, Environmental Effects Abroad of Major Federal Actions (44 FR 1957 (1979)), represents the U.S. exclusive and complete requirement for taking into account considerations with respect to actions that do significant harm to the environment of places outside the U.S. The DoD Directive 6050.7 (Environmental Effects Abroad of Major DoD Actions) provides policy and procedures to enable DoD officials to be informed of and take account of those issues. This directive establishes procedures for considering major federal actions with significant effects that take place in the global commons (Enclosure 1) and in a foreign country (Enclosure 2).

- **Overseas Environmental Compliance Issues**. Compliance with other environmental requirements is generally achieved by treaty or agreement, or by U.S. statutes having extraterritorial application. In addition, DoD Instruction 4715.5 (Management of Environmental Compliance at Overseas Installations) establishes environmental compliance standards for protection of human health and the

environment at DoD installations in foreign countries. Under this authority, the DoD has established an Overseas Environmental Baseline Guidance Document, which is a set of standards designed to protect human health and the environment. The Overseas Environmental Baseline Guidance Document and applicable international agreements constitute compliance requirements for DoD activities outside the U.S.

To further this process, the DoD designates an Environmental Executive Agent where the level of DoD presence justifies such a designation. The Environmental Executive Agent establishes Final Governing Standards, which are a comprehensive set of country-specific substantive provisions (i.e. effluent limitations, specific management practices), by comparing the Overseas Environmental Baseline Guidance Document with applicable host-national or international standards. The Environmental Executive Agent typically uses the more protective standard in establishing Final Governing Standards. Once established, the Final Governing Standards for a country constitute the environmental compliance requirements for military activities overseas in that country.

Air Quality

United States

The Clean Air Act (42 U.S.C. 7401) requires the adoption of primary and secondary National Ambient Air Quality Standards (NAAQS) to protect the public health, safety, and welfare from known or anticipated effects of the identified criteria air pollutants. The primary standards were established to protect public health with an adequate margin of safety, while the secondary standards were intended to protect the public welfare from any known or anticipated adverse effects of a pollutant (e.g., plant life, cultural monuments, and wildlife). These threshold levels were determined based on years of research on the health effects of various concentrations of pollutants on biological organisms. Exhibit G-2 summarizes the primary and secondary NAAQS.

The Clean Air Act gives state and local authorities the responsibility to ensure regional attainment of the standards. To further define local and regional air quality, the EPA designates areas with air quality better than the NAAQS as attainment areas, and areas with worse air quality as non-attainment areas. These classifications generally are based on air quality monitoring data collected at certain sites in the state. The criteria for non-attainment designation vary by pollutant. An area is in non-attainment for ozone if its NAAQS has been exceeded more than three discontinuous times in three years at a single monitoring station. An area is in non-attainment for any other pollutant if its NAAQS has been exceeded more than once per year. Some areas are unclassified because insufficient data exist to characterize the area;

Exhibit G-2. National Ambient Air Quality Standards

Standards[a]			
Pollutant	**Averaging Time**	**Concentration Primary[b,c]**	**Concentration Secondary[b,d]**
Ozone	1 hour	0.12 ppm[e] (235 $\mu g/m^3$)[f]	Same as primary
	8 hour	0.08 ppm (157 $\mu g/m^3$)	Same as primary
Carbon monoxide (CO)	8 hour	9.0 ppm (10 mg/m^3)[g]	---
	1 hour	35 ppm (40 mg/m^3)	---
Nitrogen dioxide (NO_2)	Annual arithmetic mean	0.053 ppm (100 $\mu g/m^3$)	Same as primary
Sulfur dioxide (SO_2)	1 hour	---	---
	3 hours	---	0.5 ppm (1,300 $\mu g/m^3$)
	24 hour	0.14 ppm (365$\mu g/m^3$)	---
	Annual (arithmetic mean)	0.03 ppm (80 $\mu g/m^3$)	---
Particulate matter as PM_{10}	24 hour	150 μ/m^3	Same as primary
	Annual (arithmetic mean)	50 $\mu g/m^3$	Same as primary
Particulate matter as $PM_{2.5}$	24 hour	65 $\mu g/m^3$	Same as primary
	Annual (arithmetic mean)	15 $\mu g/m^3$	Same as primary
Lead	Quarterly average	1.5 $\mu g/m^3$	Same as primary
	30-day average	---	---

Source: EPA, 2003f

[a] These standards, other than for ozone, PM, and those based on annual averages, must not be exceeded more than once per year. The eight-hour ozone standard is attained when the fourth highest eight-hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM_{10}, the 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above the standard is equal to or less than one. For $PM_{2.5}$, the 24-hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard.

[b] Concentration is expressed first in units in which it was adopted and is based on a reference temperature of 25°Celsius (°C) (77 °Fahrenheit [°F]) and a reference pressure of 760 millimeters (1,013.2 millibars) of mercury. All measurements of air quality must be corrected to a reference temperature of 25°C (77 °F) and a reference pressure of 760 millimeters (1,013.2 millibars) of mercury. Parts per million (ppm) in this exhibit refers to parts per million by volume or micromoles of pollutant per mole of gas.

[c] National primary standards are the levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[d] National secondary standards are the levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

[e] Parts per million by volume or micromoles per mole of gas

[f] Micrograms per cubic meter

[g] Milligrams per cubic meter (mg/cm^3)

other areas are deemed maintenance areas. Maintenance areas are regions where NAAQS were exceeded in the past, and are subject to restrictions specified in a State Implementation Plan (SIP)-approved maintenance plan to preserve and maintain the newly regained attainment status.

The Clean Air Act requires the preparation of a SIP that describes how the state will meet or attain the NAAQS. The SIP contains emission limitations as well as record keeping and reporting requirements for affected sources. As a result of the Clean Air Act Amendments, the requirements and compliance dates for reaching attainment are based on the severity of the air quality standard violation.

Section 176(c)(1) of the Clean Air Act mandates the general conformity rule. This requirement is further implemented in 40 CFR parts 51 and 93. The general conformity rule prohibits the Federal government from conducting, supporting or approving any actions that do not conform to an approved Clean Air Act SIP. Federal agencies are required to perform a conformity review for federal actions taking place in a region designated non-attainment for a particular pollutant, or in a maintenance area. The U.S. Federal government is exempt from the requirement to perform a conformity analysis if two conditions are met.

1. The ongoing activities do not produce emissions above the *de minimis* levels specified in the rule. Exhibit G-3 shows the *de minimis* threshold levels of various non-attainment areas.

2. The Federal action is not considered a regionally significant action. A Federal action is considered regionally significant when the total emissions from the action equal or exceed ten percent of the air quality control area's emissions inventory for any criteria pollutant.

The EPA considers emissions at or below 914 meters (3,000 feet) to evaluate ambient air quality and calculate *de minimis* levels. Air quality modeling is used to determine the effects of air emission sources on the ambient air concentrations. The types and amounts of pollutants, the topography of the air basin, and the prevailing meteorological parameters that most often affect pollutant dispersions are wind speed, wind direction, atmospheric stability, mixing height, and temperature.

Exhibit G-3. *De Minimis* Thresholds in Non-Attainment Areas

Pollutant	Degree of Non-Attainment	*De Minimis* Level (metric tons/year [tons/year])
Ozone (Volatile Organic Compounds [VOCs] and Nitrogen Oxides [NO_X])	Serious	45 (50)
	Severe	23 (25)
	Extreme	9 (10)
	Marginal/Moderate (outside ozone transport region)	45 (50 VOC)
	Marginal/Moderate (inside ozone transport region)	91 (100 NO_X)
CO	All	91 (100)
PM	Moderate	91 (100)
	Serious	64 (70)
SO_2 or NO_2	All	91 (100)
Lead	All	23 (25)

Source: 40 CFR 93.153(b)

Section 169A of the Clean Air Act established visibility protection for Class I Federal areas (such as national parks and wilderness areas). In 1999, the EPA promulgated Regional Haze regulations (64 FR 35714 (July 1, 1999)) that require states to develop SIPs to address visibility at designated mandatory Class I areas, including 156 designated national parks, wilderness areas, and wildlife refuges. General features of the regional haze regulations are that all states are required to prepare an emissions inventory of all haze related pollutants from all sources in all constituent counties. Most states will develop their regional haze SIP in conjunction with their $PM_{2.5}$ SIP over the next several years.

International

Since its adoption in 1979, the Convention on Long Range Transboundary Air Pollution has addressed some of the major environmental problems of the United Nations Economic Commission for Europe through a process of international scientific collaboration and policy negotiation. The Convention aims to protect human health and the environment against air pollution by limiting, gradually reducing, and preventing air pollution, including long-range transboundary air pollution. The objectives of the Convention Protocols are to reverse freshwater and soil acidification, forest dieback, eutrophication, exposure to excess ozone, degradation of cultural monuments and historic buildings, and accumulation of heavy metals and persistent organic pollutants in the soil, water, vegetation, and other living organisms.

The 1985 Convention for the Protection of the Ozone Layer (Vienna Convention) aims to protect human health and the environment against adverse effects resulting from modifications of the ozone layer, especially from increased ultraviolet solar radiation. It requires that states reduce their reliance on ozone-depleting substances and conduct collaborative research to find alternatives to harmful substances such as chlorofluorocarbons and halons.

The Montreal Protocol on Substances that Deplete the Ozone Layer was developed under the guidance of the United Nations Environmental Program in September 1987 and based on the recommendations of the Vienna Convention. The Montreal Protocol identifies the main ozone-depleting substances and specifies a timetable for phasing out the consumption and production of ozone depleting substances. Title VI of the Clean Air Act Amendments of 1990 establishes phase out requirements for ozone depleting substances consistent with the Montreal Protocol.

The United Nations Framework Convention on Climate Change, an international agreement for addressing climate change, was adopted at the United Nations Conference on Environment and Development (Earth Summit) in Rio de Janeiro, Brazil, in 1992. The framework aims to regulate levels of greenhouse gas concentrations in the atmosphere.

Airspace

United States

Airspace management and use in the U.S. are governed by the Federal Aviation Act of 1958 (Public Law 85-725) and its implementing regulations set forth by the FAA. FAA Order 7490, "Policies and Procedures for Air Traffic Environmental Actions," includes procedures and guidance for coordination between FAA and DoD on environmental issues regarding special use airspace. FAA Order 7610.4H, "Special Military Operations," specifies procedures for air traffic control planning, coordination, and services during defense activities, and special military operations conducted in airspace controlled by or under the jurisdiction of the FAA.

The U.S. airspace is divided into 21 zones (centers), and each zone is divided into sectors. Also within each zone are portions of airspace, about 81 kilometers (50 miles) in diameter, called Terminal Radar Approach Control airspaces. Multiple airports exist within each of these airspaces, and each airport has its own airspace with an eight-kilometer (five-mile) radius.

International

For international airspace, the procedures of the International Civil Aviation Organization (ICAO) are followed. These procedures are outlined in ICAO Document 444, "Rules of the Air and Air Traffic Services." The ICAO ensures the safe, efficient, and orderly evolution of international civil aviation through the establishment of international standards and recommended practices.

Biological Resources

United States

The Endangered Species Act of 1973 (16 U.S.C. 1531), as amended, requires all Federal agencies to seek to conserve endangered and threatened species. The Secretary of the Interior was directed to create lists of endangered and threatened species. Endangered species listing is given to any plant or animal species that is in danger of extinction throughout all or a significant portion of its range. The Act defines a threatened species as any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Critical habitat for a threatened or endangered species is defined as specific areas, within the geographical area occupied by the species at the time it is listed, which contain the physical or biological features essential to conservation of the species and may require special management considerations or protection. Critical habitat also includes specific areas, outside the geographic area occupied by the species at the time it is listed, which are essential to conservation of the species. The National Defense Authorization Act for FY 2004 (Public Law 108-136, Section 318) amended the Endangered Species Act to allow the Secretary of the Interior to exempt DoD sites from critical habitat designations if an integrated natural resources management plan is determined to be of benefit to the species.

A key provision of the Endangered Species Act for Federal activities is Section 7, Consultation. Under Section 7 of the Act, every Federal agency must consult with the Secretary of the Interior, USFWS, to ensure that an agency action is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat of such species. Under the Act, if a threatened or endangered species may be affected, a biological assessment is required to determine the impact.

The Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661) requires Federal agencies to consult with the USFWS and state wildlife agencies where any water body or wetlands under U.S. Army Corps of Engineers jurisdiction is proposed to be modified by a Federal agency.

The Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712) protects migratory waterfowl and all seabirds. Specifically, the Act prohibits the pursuit, hunting, taking, capture, possession, or killing of such species or their nests and eggs. The USFWS Division of Migratory Bird Management develops migratory bird permit policy. The regulations governing migratory bird permits can be found in General Permit Procedures (50 CFR 13) and Migratory Bird Permits (50 CFR 21). Most states require a state permit for activities involving migratory birds (USFWS, 2002). Taking of migratory birds by Federal agencies is governed by EO 13186, Responsibilities of Federal Agencies To Protect Migratory Birds (66 FR 3853 (January 17, 2001)), which requires Federal agencies taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to develop and implement a Memorandum of Understanding with the USFWS that promotes the conservation of migratory bird populations.

The Marine Mammal Protection Act of 1972 (16 U.S.C. 1361) outlines prohibitions for the taking of marine mammals. The Act gives the USFWS and NOAA Fisheries Service co-authority to protect the resource. The Marine Mammal Commission, which was established under the Act, reviews laws and international conventions, studies worldwide populations, and makes recommendations to Federal officials concerning marine mammals. The National Defense Authorization Act for FY 2004 amended the Marine Mammal Protection Act to redefine harassment as activities that “injure, disturb or are likely to disturb” marine mammals. This new standard applies to DoD actions and research done by or for the Federal government. In addition, the amendments grant the DoD an exemption from the Marine Mammal Protection Act for actions “necessary for national defense” as determined by the Secretary of Defense.

The Marine Protection, Research, and Sanctuaries Act (33 U.S.C. 1401) regulates the disposal of all materials into the ocean to prevent adverse effects to human welfare, the marine environment, ecological systems, or the economy. It provides the EPA with the authority to issue permits for ocean dumping.

The Bald and Golden Eagle Protection Act (16 U.S.C. 668) establishes penalties for the unauthorized taking, possession, selling, purchase, or transportation of bald or golden eagles, their nests, or their eggs. If a Federal activity might disturb eagles or a nest is found in areas where activities for the proposed BMDS may occur, consultation with the USFWS for appropriate mitigation is required.

The National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee) consolidates the categories of lands that are administered by the Secretary of the Interior for the conservation of fish and wildlife, including species that are threatened with extinction. Provisions of the Act relating to determinations of the compatibility of a use shall not apply to overflights above a refuge or activities authorized, funded, or conducted by a Federal agency (other than USFWS) that has primary jurisdiction over a refuge or a portion of a refuge, if the management of those activities is in accordance

with a memorandum of understanding between the Secretary/Director and the head of the Federal agency with primary jurisdiction over the refuge governing the use of the refuge.

The Magnuson–Stevens Fishery Conservation and Management Act (16 U.S.C. 1801) requires Federal agencies to consult with NOAA Fisheries on activities that could harm Essential Fish Habitat areas. Essential Fish Habitat refers to "those waters and substrate (sediment, hard bottom) necessary to fish for spawning, breeding, feeding, or growth to maturity."

The Fish and Wildlife Conservation Act of 1980 (16 U.S.C. 2901-2912) provides for financial and technical assistance to states to develop conservation plans, subject to approval by the Department of Interior, and implement state programs for fish and wildlife resources. The Act also encourages all Federal departments and agencies to utilize their statutory and administrative authority to conserve and promote conservation of non-game fish and wildlife and their habitats.

The Sikes Act (Conservation Programs on Military Installations) (16 U.S.C. 670) requires the Secretary of each military department to carry out a program for the conservation, restoration, and management of ecosystem, wildlife, and fishery resources on military reservations. Federal and state fish and wildlife agencies are given priority for managing these resources and a cooperative plan must be implemented to sell or lease land or forest products. The National Defense Authorization Act for FY 2004 amendments authorize the Secretary of the Interior to exempt DoD land from critical habitat designation where the Secretary finds that the natural resources plan prepared pursuant to the Sikes Act provides a benefit to the species for which the critical habitat designation is proposed.

EO 8646, Establishing the San Andres National Wildlife Refuge, New Mexico (6 FR 592 (1941)), creates the San Andres National Wildlife Refuge, an area that provides habitat for a variety of sensitive species, for the conservation and development of natural wildlife resources.

EO 11990, Protection of Wetlands (42 FR 26961 (1977)), requires Federal agencies to provide leadership and work to minimize the destruction, loss, and degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands while carrying out the agency's responsibility for acquiring, managing, using, and disposing of Federal lands. The National Defense Authorization Act for FY 2004 authorizes the Federal government to participate in mitigation banks for wetlands. The mitigation banks allow developers to fill wetlands in one area in exchange for a payment to create wetlands in another area.

EO 13061, Federal Support of Community Efforts Along American Heritage Rivers (62 FR 48445, 1997), requires Federal agencies to preserve, protect, and restore rivers

designated American Heritage Rivers, including their natural resources and associated historical, cultural, and economic resources.

EO 13089, Coral Reef Protection (63 FR 32701 (1998)), requires all Federal agencies to "identify their actions that may affect U.S. coral reef ecosystems; utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and to the extent permitted by law, ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems."

EO 13112, Invasive Species (64 FR 6183 (1999)), directs the prevention of invasive species introduction and provides means for their control to minimize economic, ecological, and human health impacts they may cause.

EO 13178, Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve (65 FR 76903 (2000)), establishes the Northwestern Hawaiian Island Coral Reef Ecosystem Reserve, which lies to the northwest of the main islands of the Hawaiian chain, to "ensure the comprehensive, strong, and lasting protection of the coral reef ecosystem and related marine resources and species (resources) of the Northwestern Hawaiian Islands."

The Natural Resources Management Program (DoD Directive 4700.4) instructs DoD to show active concern for natural resource value in all its efforts to achieve military missions. Under this directive, DoD must inform key decision-makers of potential conflicts between military and conservation actions.

The DoD Memorandum of Understanding to Follow the Ecosystem Approach (1995) asserts that Federal agencies should provide a leadership role in working with landowners and communities to sustain and restore the health, productivity, and biodiversity of ecosystems. The ecosystem approach should be integrated with social and economic goals in a way that improves the overall quality of life.

International

The Convention on Wetlands of International Importance Especially as Waterfowl Habitat, or Ramsar Convention, has been in force since 1975 and aims to stem the progressive encroachment on and loss of wetlands, now and in the future. It requires its Parties to designate at least one national wetland of international importance; establish wetlands nature reserves and cooperate in information exchange for wetlands management; assess the impacts of any changes in use on identified wetland sites; and take responsibility for conservation, management, and wise use of migratory stocks of waterfowl.

The 1986 Convention for the Protection of the Natural Resources and Environment of the South Pacific Region is a comprehensive, umbrella agreement for the protection,

management, and development of the marine and coastal environment of the South Pacific Region. Sources of pollution that require control under SPREP are ships, dumping, land-based sources, seabed exploration and exploitation, atmospheric discharges, storage of toxic and hazardous wastes, testing of nuclear devices, mining, and coastal erosion.

Cultural Resources

Numerous laws and regulations require that possible effects on cultural resources be considered during the planning and execution of Federal undertakings. These laws and regulations stipulate a process of compliance, define the responsibilities of the Federal agency proposing the action, and prescribe the relationship among other involved agencies (e.g., State Historic Preservation Officer, the Advisory Council on Historic Preservation).

The National Historic Preservation Act (16 U.S.C. 470f and 470h-2(a)) establishes a national policy to preserve, restore, and maintain cultural resources. The Act establishes the National Register of Historic Places as the mechanism to designate public or privately owned properties deserving protection. Federal agencies must take into account the effect of a project on any property included in or eligible for inclusion in the National Register.

The Native American Graves Protection and Repatriation Act (25 U.S.C. 3001) is triggered by the possession of human remains or cultural items by a federally funded repository or by the discovery of human remains or cultural items on Federal or tribal lands. It provides for the inventory, protection, and return of cultural items to affiliated Native American groups. Permits are required for intentional excavation and removal of Native American cultural items from Federal or tribal lands. The Act includes provisions that, upon inadvertent discovery of remains, the action will cease in the area where the remains were discovered, and the responsible official will protect the materials and notify the appropriate lands management agency.

The Archaeological Resources and Protection Act (16 U.S.C. 470aa - 470mm) ensures the protection of archaeological sites on Federal land. It requires Federal permits to be obtained before cultural resource investigations begin at sites on Federal land and investigators to consult with the appropriate Native American groups prior to initiating archaeological studies on sites of Native American origin.

The American Indian Religious Freedom Act (42 U.S.C. 1996) states that it is the policy of the U.S. to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonial and traditional rites.

The Antiquities Act of 1906 (16 U.S.C. 431) was the first piece of historic preservation legislation, and it protects sites and objects of antiquity, including historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest that are situated upon lands owned or controlled by the U.S. The Act prohibits excavation or destruction of such antiquities unless a permit is obtained. Antiquity permits issued under this law are still in effect, though new permits are now being issued under the Archaeological Resources Protection Act of 1979 (16 U.S.C. § 470aa-mm) and its implementing regulations (43 CFR 7). These regulations enable Federal land managers to protect archaeological resources, taking into consideration provisions of the American Indian Religious Freedom Act (42 U.S.C. 1996), through permits authorizing excavation and/or removal of archaeological resources, through civil penalties for unauthorized excavation and/or removal, through provisions for the preservation of archaeological resource collections and data, and through provisions for ensuring confidentiality of information about archaeological resources when disclosure would threaten the archaeological resources.

EO 13007, Indian Sacred Sites (61 FR 26771 (1996)), requires each executive branch that manages Federal lands, whenever practicable and permitted by law, to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and to avoid adversely affecting the physical integrity of such sacred sites.

EO 13287, Preserving America (68 FR 10635 (2003)) establishes Federal policy to provide leadership in preserving America's heritage by actively advancing the protection, enhancement, and contemporary use of the historic properties owned by the Federal Government, and by promoting intergovernmental cooperation and partnerships for the preservation and use of historic properties.

Environmental Justice

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (56 FR 7629 (1994)) requires each Federal agency to identify and address, as appropriate, "disproportionately high and adverse human health and environmental effects on minority and low-income populations." The demographics of the affected area should be examined to determine whether minority populations or low-income populations are present in the area impacted by the proposed action. If so, a determination must be made whether the implementation of the proposed action may cause disproportionately high and adverse human health or environmental effects on those populations.

Geology and Soils

Although there are no Federal regulations pertaining specifically to geology and soils in areas where activities for the proposed BMDS may occur, some water quality regulations are indirectly related with respect to erosion and resultant turbidity (mixing) in surface waters (Clean Water Act sections 402 and 405 National Pollutant Discharge Elimination System (NPDES) permitting program, codified at 40 U.S.C. 1342 and 1345, respectively), avoidance of development in floodplains (EO 11988, Floodplain Management), and spill response plans to ensure that ground water is not adversely impacted. (U.S. Army Space and Missile Defense Command, 2003)

Several states and counties have regulations or ordinances in place to protect and mitigate impacts to soils. Such regulations and procedures include best management practices, which typically are outlined in sediment and erosion control handbooks (e.g. Virginia Erosion and Sediment Control Handbook). The Best Management Practices outlined in the state and local handbooks are designed to address the storm water run-off and water quality criteria specified in the Clean Water Act. (See discussion under Water Resources.)

Hazardous Materials and Hazardous Waste

United States

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or Superfund, (42 U.S.C. 9601) creates authority and procedures for conducting emergency responses, removal, and remediation actions at sites requiring a cleanup of releases of hazardous substances. The Act specifies standards of liability and provides procedures for determining compensation, reportable quantities of releases of hazardous substances, penalties, employee protection, claims procedures, and cleanup standards.

The Superfund Amendment and Reauthorization Act of 1986 revised and extended CERCLA in 1986. SARA Title III, the Emergency Planning and Community Right To Know Act, provides for emergency planning and preparedness, community right-to-know reporting, and toxic chemical release reporting. The Act requires information about hazardous materials be provided to state and local authorities, including material safety data sheets, emergency and hazardous chemical inventory forms, and toxic chemical release reports.

Resource Conservation and Recovery Act (RCRA), or Solid Waste Disposal Act, (42 U.S.C. 6901) authorizes the EPA to regulate the generation, storage, and disposal of hazardous wastes. RCRA also applies to underground storage tanks and establishes a

“cradle-to-grave” or life cycle system of requirements for managing hazardous waste, from generation to eventual disposal.

The Pollution Prevention Act of 1990 (42 U.S.C. 13101) defines pollution prevention as source reduction and other practices that reduce or eliminate the creation of pollutants. It requires the EPA to develop standards for measuring waste reduction, serve as an information clearinghouse, and provide matching grants to state agencies to promote pollution prevention. Facilities with more than ten employees that manufacture, import, process, or otherwise use any chemical listed in and meeting threshold requirements of the Emergency Planning and Community Right To Know Act must file a toxic chemical source reduction and recycling report.

The Hazardous Materials Transportation Act of 1975 (49 U.S.C. 1801) gives the DOT authority to regulate shipments of hazardous substances by air, highway, or rail. These regulations may govern any safety aspect of transporting hazardous materials, including packing, repacking, handling, labeling, marking, placarding, and routing (other than with respect to pipelines).

The Ocean Dumping Act (33 U.S.C. 1401) imposes restrictions on what items and substances may be dumped into the open ocean. To protect the marine environment, the Act restricts dumping to designated locations and strictly prohibits dumping of materials such as biological warfare substances. The U.S. Coast Guard conducts surveillance as a regulatory enforcement measure.

The Oil Pollution Act of 1990 (33 U.S.C. 2701) requires oil storage facilities and vessels to submit to the Federal government plans detailing how they will respond to large discharges. The Oil Pollution Act requires the Federal government to “ensure effective and immediate removal of a discharge, and mitigation or prevention of a substantial threat of a discharge, of oil or a hazardous substance” into the navigable waters of the U.S., adjoining shorelines, and the exclusive economic zone. The Act requires the development of Area Contingency Plans to prepare and plan for oil spill response on a regional scale.

The Toxic Substances Control Act of 1976 (15 U.S.C. 2601) gives the EPA authority to require testing of new and existing chemical substances entering the environment and the authority to regulate these substances. Section 6 of the Act specifically addresses, among others, polychlorinated biphenyls and asbestos.

EO 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements (58 FR 41981 (1993)), requires the head of each Federal agency to develop and implement a written pollution prevention strategy that aims to minimize release of toxic chemicals to the environment and report in a public manner toxic chemicals entering the waste stream of the agency. This order relates to compliance with the

Emergency Planning and Community Right To Know Act and the Pollution Prevention Act.

International

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, generally known as the London Dumping Convention, was adopted in 1972. Its objective is to control pollution of the sea caused by dumping and to encourage regional agreements supplementary to the Convention. It prohibits the dumping of certain hazardous materials, requires a prior special permit for the dumping of a number of other identified materials, and requires a prior general permit for other wastes or matter.

"Dumping" has been defined as the deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures, as well as the deliberate disposal of these vessels or platforms themselves. Discharges of spent stages from missiles and of residual propellants are part of the normal operation of launch vehicles, and therefore are not covered by the London Dumping Convention or other related agreements.

The U.S. is party to the Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships of 1973 as Amended (MARPOL) and Annexes I, II, III, and IV to MARPOL. Normal debris released by missiles after launch is not covered by MARPOL, as this agreement applies to ships. After lift-off from the launch pad, vehicles and their payloads are not ships within the meaning of MARPOL.

The 1989 Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention) aims to establish obligations for State Parties with the objective of reducing transboundary movements of wastes subject to the Basel Convention to a minimum consistent with the environmentally sound and efficient management of such wastes; minimizing the amount and toxicity of hazardous wastes generated and ensuring their environmentally sound management (including disposal and recovery operations) as close as possible to the source of generation; and assisting developing countries in environmentally sound management of the hazardous and other wastes they generate. Hazardous wastes shall be exported only if the state of export does not have the technical capacity and facilities to dispose of them in environmentally sound management.

Health and Safety

Regulatory requirements related to the Occupational Safety and Health Act of 1970 (29 U.S.C. 651 et seq.) have been codified in the General Industry Standards (29 CFR 1910) and Construction Industry Standards (29 CFR 1926). The regulations specify equipment, performance, and administrative requirements necessary for compliance with Federal

occupational safety and health standards, and apply to all occupational (workplace) situations in the U.S. The requirements are monitored and enforced by the Occupational Safety and Health Administration, which is a part of the U.S. Department of Labor.

The Occupational Safety and Health Standards (OSHA) regulations (29 CFR 1910) address electrical and mechanical safety and work procedures, sanitation requirements, life safety requirements (such as fire and evacuation safety and emergency preparedness), design requirements for certain types of facility equipment (such as ladders and stair lifting devices), mandated training programs (such as employee Hazard Communication training and use of powered industrial equipment), and record-keeping and program documentation requirements. For any construction or construction-related activities, additional requirements specified in the Safety and Health Regulations for Construction (29 CFR 1926) also apply.

The Safe Drinking Water Act provides the EPA with the authority to set standards for drinking water quality and oversee states, localities, and water suppliers who implement those standards. Additional information on the Safe Drinking Water Act can be found in Section 3.1.15, Water Resources.

RCRA gave the EPA the authority to control hazardous waste from "cradle-to-grave." This includes generation, transportation, treatment, storage, and disposal of hazardous waste. Additional information on RCRA can be found in Section 3.1.7, Hazardous Materials and Hazardous Waste.

The Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 (33 U.S.C. 1251) has special enforcement provisions for oil and hazardous substances. For example, the Spill Prevention Control and Countermeasure (SPCC) Plan covers the release of hazardous substances, as identified by EPA, which could reasonably be expected to discharge into the waters of the U.S. Additional information on the Clean Water Act can be found in Section 3.1.15, Water Resources.

Requirements pertaining to the safe shipping and transport handling of hazardous materials, which can include hazardous chemical materials and explosives, are found in the DOT Hazardous Materials Regulations and Motor Carrier Safety Regulations (49 CFR parts 107, 171-180 and 390-397). These regulations specify all requirements that must be observed for shipment of hazardous materials over highways or by air. Requirements include those for specific packaging, material compatibility issues, permissible vehicle/shipment types, vehicle marking, driver training and certification, and notification.

Safety and Health Regulations for Marine Terminals (29 CFR 1917) apply to employment within a marine terminal including the loading, unloading, movement or other handling of cargo, ship's stores, or gear within the terminal or into or out of any

land carrier, holding or consolidation area, and any other activity within and associated with the overall operation and functions of the terminal, such as the use and routine maintenance of facilities and equipment. Cargo transfers accomplished with the use of shore-based material handling devices also are regulated.

Safety and Health Regulations for Longshoring (29 CFR 1918) applies to longshoring operations and related employments aboard marine vessels.

EO 13045, Protection of Children from Environmental Health Risks and Safety Risks (62 FR 19885 (1997)), as amended by EO 13229 (66 FR 52013 (2001)) and EO 13296 (68 FR 19931 (2003)), provides for the consideration of potential environmental effects from federal actions on health and safety risks that may disproportionately affect children.

Defense Directive 3200.11, Major Range and Test Facility Base, provides the framework under which the national ranges operate and provide services to range users.

Range Commanders Council (RCC) Standard 321-02, Common Risk Criteria for National Test Ranges, sets requirements for minimally acceptable risk criteria to occupational and non-occupational personnel, test facilities, and non-military assets during range operations. Methodologies for determining risk also are set forth.

RCC 319-92, FTS Commonality Standards, specifies performance requirements for flight termination systems used on various flying weapons systems.

DoD 6055.9-STD, DoD Ammunition and Explosives Safety Standards describes appropriate safety measures to be followed during loading of missiles and propellants as required by DoD.

Land Use

United States

The Coastal Zone Management Act (16 U.S.C. 1451) seeks to preserve, protect, and restore coastal areas. Coastal areas include wetlands, floodplains, estuaries, beaches, dunes, barrier islands, coral reefs, and fish and wildlife and their habitat. All Federal agencies must assess whether their activities will affect a coastal zone and ensure, to the maximum extent possible, that the activities are consistent with approved state Coastal Zone Management Plans.

The Farmland Protection Act of 1981 (7 U.S.C. 4201) is designed to require Federal agencies to consider alternatives to projects that would convert farmlands to nonagricultural use. The Act is limited to procedures to assure that the actions of Federal agencies do not cause U.S. farmland to be irreversibly converted to nonagricultural uses

in cases in which other national interests do not override the importance of the protection of farmland nor otherwise outweigh the benefits of maintaining farmland resources.

The Wilderness Act of 1964 (16 U.S.C. 1131-1136) provides Congressional protection of several named wilderness areas and establishes a National Wilderness Preservation System for inclusion of lands within national forests, national parks, and national wilderness refuges.

The Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701) repeated a number of public land statutes and instituted a number of new programs including review of all lands managed by the Bureau of Land Management for possible designation by Congress as "wilderness," including a stipulation that the Federal agency must manage the public lands so as not to impair their wilderness potential.

International

The Convention on Environmental Impact Assessment in a Transboundary Context of 1991 aims to promote environmentally sound and sustainable economic development through the application of environmental impact assessment, especially as a preventive measure against transboundary environmental degradation. It stipulates the obligations of Parties to assess the environmental impact of certain activities at an early stage of planning. It also requires states to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries.

Noise

Federal and state governments have established noise regulations and guidelines for the purpose of protecting citizens from potential hearing damage and various other adverse physiological, psychological, and social effects associated with noise. The Federal government preempts the state on control of noise emissions from aircraft, helicopters, railroads, and interstate highways.

The Noise Control Act (42 U.S.C. 4901) directs all Federal agencies, to the fullest extent within their authority, to carry out programs in a manner that promotes an environment that is free from noise. The act requires a Federal department or agency engaged in any activity resulting in the emission of noise to comply with Federal, state, interstate, and local requirements respecting control and abatement of environmental noise.

OSHA regulations (29 CFR 1910.95) establish a maximum noise level of 90 A-weighted decibel (dBA) for a continuous eight-hour exposure during a workday and higher sound levels for a shorter time of exposure in the workplace. When information indicates that

an employee's exposure may equal or exceed an eight-hour time-weighted average of 85 dB, the employer shall develop and implement a monitoring program.

The DoD Noise–Land Use Compatibility Guidelines state that sensitive land use areas, such as residential areas, are incompatible with annual day/night average sound level (L_{dn}) greater than 65 dBA.

Socioeconomics

The CEQ implementing regulations for NEPA provide no specific thresholds of significance for socioeconomic impact assessment. Significance varies depending on the setting of the proposed action (40 CFR 1508.27(a)). However, 40 CFR 1508.8 states that indirect effects may include those that are growth inducing and others related to induced changes in the pattern of land use, population density, or growth rate.

Transportation and Infrastructure

Regulations pertaining to transportation are implemented by the DOT and are located in Title 49 of the CFR. Title 49 includes regulations applicable to railroads (49 CFR 200-299), highways (49 CFR 300-399; 49 CFR 500-599), coastal transportation (49 CFR 400-499), transportation safety (49 CFR 800-899), and surface transportation generally (49 CFR 1000-1199). In addition, the DOT oversees air transportation and the applicable regulations are located at Title 14 of the CFR.

Utilities

There are significant numbers of legal requirements that exist for utilities; however, these are most appropriately considered in action- and site-specific environmental analyses. Therefore they will not be included in this PEIS. Subsequent site-specific environmental analyses will examine the applicable legal requirements for utilities, including Federal, state, and local regulations.

Visual and Aesthetic Resources

There are no Federal aesthetics permits or regulations for visual resources applicable to the proposed action and alternatives. Local planning guidelines may be included in city and county general plans to preserve and enhance the visual quality and aesthetic resources within the plan's jurisdiction. Protection of visual resources typically results from local zoning and building ordnances.

Water Resources

The Clean Water Act (33 U.S.C. 1251) establishes water pollution control standards and programs with the objective of restoring and maintaining the chemical, physical, and biological integrity of U.S. water resources. The Act provides for the elimination of the discharge of pollutants into navigable waters and for water quality goals to protect fish and wildlife. The Act specifies (1) that actions must comply with Federal and state water quality criteria; (2) regulations for issuing permits under the NPDES for storm water discharge be established by the EPA; and (3) states assess non-point source water pollution problems and develop pollution management plans.

Water quality and the consumption and diversion of water are regulated by a number of Federal and state agencies in the U.S. The EPA has the primary authority for implementing and enforcing the Clean Water Act. (33 U.S.C. 1251) The EPA, along with state agencies to which the EPA has delegated some of its authority, issues permits under the Clean Water Act to maintain and restore the quality of U.S. water resources. The Clean Water Act requires permits for activities that result in the discharge of pollutants to water resources or the placement of fill material in waters of the U.S.

Storm Water Pollution Prevention Plans are typically prepared and permitted under the NPDES to ensure construction activities do not lead to unacceptable levels of erosion and water pollution. The Safe Drinking Water Act of 1974 (42 U.S.C. 300f) provides the EPA with the authority to regulate the quality of U.S. drinking water supplies, including surface water and ground water sources. The EPA has delegated some of its authority for enforcement to all of the states, with the exception of Wyoming and the District of Columbia. The appropriation of water, including diversions, consumption of potable water, and other uses usually is regulated by the same state agencies that regulate water quality.

EO 11988, Floodplain Management (42 FR 26951 (1977)), requires Federal agencies to provide leadership and work to minimize the impacts of floods on property loss and human health and safety and simultaneously preserving the natural and beneficial values served by floodplains while carrying out the agency’s responsibility for acquiring, managing, using, and disposing of Federal lands.

Orbital Debris

The President authorized a new national space policy on August 31, 2006 that establishes overarching national policy that governs the conduct of U.S. space activities. The directive states:

"Orbital debris poses a risk to continued reliable use of space-based services and operations and to the safety of persons and property in space and on Earth. The United States shall seek to minimize the creation of orbital debris by government and non-government operations in space in order to preserve the space environment for future generations. Toward that end:

- Departments and agencies shall continue to follow the United States Government Orbital Debris Mitigation Standard Practices, consistent with mission requirements and cost effectiveness, in the procurement and operation of spacecraft, launch services, and the operation of tests and experiments in space;

- The Secretaries of Commerce and Transportation, in coordination with the Chairman of the Federal Communications Commission, shall continue to address orbital debris issues through their respective licensing procedures; and

- The United States shall take a leadership role in international fora to encourage foreign nations and international organizations to adopt policies and practices aimed at debris minimization and shall cooperate in the exchange of information on debris research and the identification of improved debris mitigation practices."

APPENDIX H
BIOME DESCRIPTIONS

BIOME DESCRIPTIONS

This Appendix provides detailed descriptions for each of the nine terrestrial biomes and the Broad Ocean Area (BOA) and the Atmosphere as discussed in Section 3, Affected Environment.

H.1 Arctic Tundra Biome

The Arctic Tundra Biome[12] discussion encompasses the arctic coastal regions that border the North Atlantic Ocean and Arctic Ocean. This biome includes coastal portions of Alaska in the U.S., Canada, and Greenland (administered by Denmark).

The majority of the Arctic Tundra Biome is located north of the latitudinal tree line and consists of the northern continental fringes of North America from approximately the Arctic Circle northward. For example, Thule AFB, Greenland, which is located approximately 1,100 kilometers (700 miles) north of the Arctic Circle, is the northernmost installation where MDA activities for the proposed BMDS may occur. The Arctic Tundra Biome includes other coastal locations that may be situated south of the Arctic Circle but have a climate and ecosystem similar to that of inland Arctic Tundra. These sites are located on the islands of the Aleutian chain and include Eareckson Air Station, Shemya Island, Alaska, and Adak, Alaska.

H.1.1 Air Quality

Climate

The Arctic Tundra Biome has very short, cool summers and long, severe winters. No more than 188 days per year, and sometimes as few as 55, have a mean temperature higher than 0°Celsius (°C) (32°Fahrenheit [°F]). On average, the frost-free period ranges from 40 to 60 days. The average annual temperature is -28°C (-18°F). Nights can last for weeks when the sun barely rises during winter months, and the temperature can drop to -70°C (-94°F). During the summer, the sun shines almost 24 hours per day and average summer temperatures range from 3°C to 16°C (37°F to 60°F).

The climate of the Arctic Tundra Biome is characterized as polar maritime with persistent overcast skies, high winds, frequent and often violent storms, and a narrow range of temperature fluctuation throughout the year. Weather at these coastal sites tends to be localized. (U.S. Army Space and Missile Defense Command, 2003) Parts of the Arctic Tundra may be classified as desert due to low precipitation. Annual precipitation is light, often less than 200 millimeters (eight inches). Most precipitation falls as snow in

[12] Exhibit H-12 shows the global location of the Arctic Tundra ecosystem. However, based on reasonably foreseeable locations for activities for the proposed BMDS to occur, the affected environment highlights the coastal portions of this ecosystem.

October through November. However, because potential evaporation also is very low, the climate tends to be humid. The Arctic Tundra also is characterized by high winds, which can blow from 48 to 97 kilometers (30 to 60 miles) per hour.

The Aleutian Islands are a representative example of locations where activities for the proposed BMDS may occur, and persistent cloudy weather, fog, mist, drizzle, and rain borne on powerful driving winds characterize the climate of the Aleutian Islands. Cold ocean currents keep land temperatures consistently cool, even during the warmest summer weather. The mean daily temperature in the Aleutian Islands of 3.9°C (39°F) has an annual range of only ± 9.4°C (49°F). (U.S. Geologic Survey [USGS], 1999) The Aleutian Islands typically receive some form of precipitation every day of the year, which averages approximately 76 to 137 centimeters (30 to 54 inches) annually, usually in the form of rain. Local shifts and rapid changes in velocity characterize the wind conditions of sites located on the Aleutian Islands.

Regional Air Quality

Air quality in the Arctic Tundra Biome is considered good, however, some areas in and around urban centers are in non-attainment for CO. Mixing heights in the Arctic Tundra Biome adversely affect regional air quality and vary greatly depending on atmospheric conditions. The mixing height is highest during afternoon hours and lowest during the evening and early morning. Temperature inversions, which occur most often in the winter, may cause extended periods of low mixing heights. Low mixing heights adversely affect regional air quality. During episodes of cold winter weather, atmospheric inversions may trap contaminants and cause exceedances of U.S. NAAQS or regional standards.

The Aleutian Islands are located in an attainment area for ambient concentrations of air pollutants. Although there is little actual ambient air quality monitoring in the Aleutians, the climate of the islands is conducive to good air quality, except during times of very high winds and dry weather, when blowing, natural dust can occur. The wet conditions of these coastal regions help to reduce windblown dust. (U.S. Army Space and Missile Defense Command, 2003)

Existing Emission Sources

Major emissions sources associated with proposed BMDS activities in the Arctic Tundra Biome include boilers, engines, hush houses, gas stations, fuel handling, chemicals, generators, storage tanks, miscellaneous equipment, and prescribed burning/firefighter training. Title V Air permits are maintained or applications have been submitted for some sites where proposed BMDS activities may occur. Existing natural emissions surrounding the Aleutian Islands stem primarily from regional volcanic activity.

The Arctic Tundra region absorbs more CO_2 than it releases. During the short summer, tundra plants absorb CO_2 through photosynthesis and release CO_2 through decomposition. However, due to the short, cool summer and freezing winter temperatures, plants cannot decompose. Remains of plants thousands of years old have been found in the tundra permafrost. In this way, the tundra traps the CO_2 and removes it from the atmosphere. However, every year an area of tundra permafrost melts and is lost due to rising global temperatures. As the tundra permafrost melts, the plant mass decomposes and returns CO_2 to the atmosphere.

H.1.2 Airspace

Controlled and Uncontrolled Airspace

Airspace above U.S. military airfields in the Arctic Tundra Biome includes controlled airspace and operates under Instrument Flight Rules (IFR). Alaskan airspace is located within the Anchorage Oceanic Control Area/Flight Information Region and within the U.S. Alaskan Air Defense Identification Zone. The Anchorage Air Route Traffic Control Centers (ARTCC) controls Alaskan airspace. Communication and radar products are sent and received at the Anchorage Center via satellite, ground, and microwave transmitters and receivers. Due to the mountainous terrain, many areas have marginal to no communications and may lack radar coverage. The publication, *Flight Tips for Pilots in Alaska*, provides information to pilots flying to and within Alaska. It should be used in addition to the current Alaska Supplement, Sectional Aeronautical Charts, World Aeronautical Charts, Airmen's Information Manual, current Notices to Airmen (NOTAMs), and current weather briefings.

The Arctic Tundra Biome also includes regions that are located in international airspace and therefore, the procedures of the ICAO are followed. Flight plans, notifications, and itineraries are mandatory for all operations over Canadian terrain. Current NOTAMs should be obtained, as well as the Canadian Flight Supplement, which updates the aeronautical charts every 56 days and lists facility frequencies. In sparsely settled areas, Air Navigation Orders require aircraft to be equipped with certain radio and emergency equipment. In addition, the Transport Canada Aviation Group has designated a mandatory frequency for use at selected aerodromes or aerodromes that are uncontrolled during certain hours.

The Danish Civil Aviation Administration is the authority in Greenland, where Thule AFB is located. Controlled airspace includes the Sondrestrom Flight Information Region for operations outside the shoreline of Greenland. Much of the airspace in Greenland is uncontrolled. With the exception of control zones and terminal control areas at Sondrestrom Airport and Thule AFB, the Sondrestrom Flight Information Region is uncontrolled airspace below Flight Level (FL) 195.

Special Use Airspace

Alaska has some of the largest Military Operations Areas (MOAs) in the world. Much of Alaska's aviation activity takes place within existing MOAs, through a shared-use agreement, with information provided by the Special Use Airspace Information Service, which is a system operated by the USAF under agreement with the FAA Alaskan Region to assist pilots with flight planning and situational awareness while operating in or around MOAs or Restricted Areas in interior Alaska. The service provides a means for civil and USAF pilots to obtain information regarding activity of aircraft so that pilots can fly safely in those areas. Pilots must be aware of the hazards associated with sharing special use airspace with aircraft of vastly different capabilities, as civilian aircraft are considerably slower and less maneuverable than their military counterparts.

In Canada, the Air Navigation Services and Airspace Services of Transport Canada are responsible for issues involved with airspace utilization and classification, levels of service for Air Navigation Service facilities, and services, including weather, navigation, radar, and communication services. Transport Canada issues NOTAMs regarding special use airspace and closures in Canada.

In Greenland, the Danish Civil Aviation Administration issues NOTAMs regarding restricted airspace. Special use airspace typically involves military ranges.

Airports/Airfields

Civilian, military, and private airports exist in the Arctic Tundra Biome. There are five major civilian airports, over 650 other airports registered with the FAA, and more than 3,000 airstrips in Alaska, most of which are designed for small aircraft, such as single engine planes and helicopters. Most of the airports are owned and operated by the State of Alaska and certified by the FAA. However, many airports are private and not maintained on a regular basis. As a result, runway conditions may not be favorable at some airport locations. Existing military airfields, which have runways that are paved and in good condition, would be used to support activities for the proposed BMDS.
The National Airports System of Canada is comprised of a core network of 26 airports that currently handles over 90 percent of all scheduled passenger and cargo traffic in Canada. These airports are the points of origin and destination for almost all inter-provincial and international air service in Canada. Locations of these airports include national, provincial, and territorial capitals, as well as airports that handle at least 200,000 passengers each year. Canada also has regional, local, military, and remote airports.
Greenland has both civilian and military airports, many of which are located in remote areas and have unpaved runways. Three airports in Greenland handle international flights, while the rest are used for air transportation between towns where ground transportation is not available.

En Route Airways and Jet Routes

Civilian aircraft generally fly along established flight corridors that operate under Visual Flight Rules (VFR). Numerous Minimum En route Altitudes are present in Alaska. Minimum En route Altitudes from 2,400 to 4,000 meters (8,000 to 13,000 feet) are common throughout the state, and in some areas they can be as high as 7,000 meters (23,000 feet).

The Transport Canada Aviation Group and Danish Civil Aviation Administration establish Minimum En route Altitudes and other routes for Canada and Greenland, respectively.

H.1.3 Biological Resources

Vegetation

Much of the Arctic Tundra Biome lies beyond the latitudinal tree line. As a result, vegetation on the Arctic Tundra consists of grasses, sedges, lichens, and willow shrubs. Tundra is characterized by treeless areas, which consist of dwarfed shrubs and miniature wildflowers adapted to a short growing season. At southern latitudes of the Arctic Tundra the vegetation changes into birch-lichen woodland and then into needleleaf forest. In some places, a distinct tree line separates forest from tundra. In the Arctic Tundra, the ground remains frozen beneath the top layer of soil, preventing trees from sending their roots down. Willows are able to grow on some parts of the Arctic Tundra, but only as low carpets about eight centimeters (three inches) high. Most plants grow in a dense mat of roots that has developed over thousands of years.

Vegetation common to the Arctic Tundra region includes arctic moss (*Calliergon giganteum*), arctic willow (*Salix arctica*), bearberry (*Arctostaphylos Uva-Ursi*), caribou moss (*Cladonia rangifernia*), diamond-leaf willow (*Salix pulcha*), labrador tea (*Ledum latifolium*), pasque flower (*Pulsatilla vulgaris*), and tufted saxifrage (*Saxifraga caespitosa*). Wet meadows are extensive throughout the Arctic Tundra region. Despite low annual precipitation, lakes and ponds are abundant, and their margins in certain seasons are red with Arctic pendantgrass (*Arctophila fulva)*. Wet meadows are dominated by pure and mixed stands of water sedge (*Carex aquatilis*), cottongrass (*Eriophorum*), and tundra grass (*Dupontia fisheri*). Exposed lake bottoms offer bare soil for colonization by plants.

Outside the reach of the modifying effects of the ocean, rises in temperature and changes in plants are significant. Tussock tundra is absent near the coast of the Arctic Ocean but is the dominant vegetation type inland and in the arctic foothills. Only prostrate (low-lying, horizontal) shrubs occur near the coast, but the abundance of willows increases inland, especially in riparian settings. Dwarf birch (*Betula nana*) forms thickets on the

southern uplands. Balsam poplar (*Populus balsamifera*) persists well north of the tree line in the headwaters of several arctic rivers where gravels, through which ground water passes, are sheltered by benches and bluffs. (USGS, 1999)

Vegetation in the Aleutian Islands differs from that of mainland Arctic Tundra. For example, on Shemya Island, the predominant vegetative associations consist of beach grass (*Ammophila breviligulata*) that tends to colonize disturbed areas, and remnants of crowberry (*Empetrum* sp.) tundra. Beach grass dominates the shorelines within bays, inlets, and coves of the island. Other plants inhabiting this area are beach pea (*Lathyrus japonicus*), seabeach sandwort (*Honkenya peploides*), cow parsnip (*Heracleum maximum*), cinquefoil (*Potentilla sp.*), and species of sedge. The Aleutian tundra is composed mainly of grasses, sedges, heath, and composite families with an almost continuous mat of mosses and lichens. Dwarf shrubs such as crowberry, cloudberry (*Rubus chamaemorus*), lapland cornel (*Cornus suecica*), and blueberry (*Vaccinium* sp.) are located at higher elevations with better drainage. Forbs such as bistort (*Polygonum bistorta*), buttercup (*Ranunculaceae*), lousewort (*Pedicularis)*, monkshood (*Aconitum species)*, and violet (*Viola odorata*) are scattered throughout Shemya Island. There are no large native trees. Eelgrass (*Zostera marina*) beds are confined to lagoons and estuaries and are an important food source for waterfowl and invertebrates and provide food and rearing habitat for juvenile groundfish and salmon. Pondweed (*Potamogeton sp.*), water milfoil (*Myriophyllum spicatum*), and mare's tail (*Hippuris vulgaris L.***)** are the primary freshwater vegetation. Large mosses and leafy liverworts are located in freshwater Aleutian streams. (U.S. Army Space and Missile Defense Command, 2000)

Although plant cover in the Aleutian Islands is sparse, the mountainous backbone of the islands and the fell-fields on the exposed slopes and ridge crests (even near sea level) provide habitats for some plants that are endemic to the Aleutians. These include Aleutian draba (*Draba aleutica)*, Aleutian chickweed (*Cerastium beringinanum* variety *aleuticum)*, Aleutian wormwood (*Artemisia aleutica)*, Aleutian shield-fern (*Polystichum aleuticum)*, and Aleutian saxifrage (*Saxifraga aleutica)*. Aleutian wormwood is known from only two islands, and the Aleutian shield fern is known only from Adak and is federally listed as an endangered species. Personnel at the Alaska Maritime National Wildlife Refuge, which administers the area, are attempting to find additional Aleutian shield fern populations and to protect the species from damage by introduced caribou. (USGS, 1999)

On numerous sites where activities for the proposed BMDS may occur, native vegetation has been removed, and the land is landscaped and maintained by mowing and brush control measures. Isolated pockets of vegetation may remain on sites where activities for the proposed BMDS may occur, however, vegetation on off-site areas is widespread and may be undisturbed.

Wildlife

Species of land mammals found on the Arctic Tundra consist of slightly modified shrews, hares, rodents, wolves, foxes, bears and deer. Large herds of caribou, or reindeer, which feed on lichens and plants, are present in North America. There are also smaller herds of musk oxen (*Ovibos Moschatus*). Wolves, wolverines (*Gulo gulo*), arctic foxes *(Alopex Lagopus)*, and polar bears (*Ursus maritimus*) are the predators of the Arctic Tundra. Smaller mammals include snowshoe rabbits (*Lepus Americanus*) and lemmings. Insect species are limited in the tundra, but black flies (*Simuliidae)*, deer flies (*Chrysops spp.*), mosquitoes (*Diptera – order*) and "no-see-ums" (tiny biting midges [*Culicoides furens*]) appear during the summer. Migratory birds such as the harlequin duck (*Histrionicus histrionicus*), sandpipers, and plovers have been sighted in marshy areas of the tundra.

Several lakes in the Arctic Tundra region support a small, unique assemblage of freshwater fishes, including Arctic grayling (*Thymallus Arcticus*), lake trout (*namaycush*), and burbot (*Lota lota*). However, many lakes and streams in the region, especially in mountainous areas, freeze severely in winter, often to the bottom. Consequently, habitat becomes extremely limited in winter, and fish may become concentrated in small areas of rivers and at the bottom of lake basins. In the Aleutian waters, freshwater fish species most used by humans are the Dolly Varden (*Salvelinus malma Walbaum*) and sockeye (*Oncorhynchus nerka*), pink (*Oncorhynchus gorbuscha*), coho (*Oncorhynchus kisutch*), and chum salmon (*Oncorhynchus keta*). (USGS, 1999)

Arctic mountain lakes support small numbers of breeding waterfowl, primarily ducks, during the summer. Golden eagles (*Aquila chrysaetos*) and merlins (*Falco columbarius*) commonly breed in mountainous regions of the Arctic Tundra, and gyrfalcons (*Falco rusticolus*) and peregrine falcons (*Falco peregrinus*) may nest where suitable cliff-nesting habitats are available. The Aleutian Islands provide nesting habitat for about ten million seabirds, which all feed heavily on fishes in the marine environment and may eat locally spawned young salmon. (USGS, 1999)

Marine mammals with Federal or state threatened or endangered status that may occur in the Aleutian Islands include the Steller sea lion (*Eumetopias jubatus*), northern sea otter (*Enhydra lutris)*, blue whale (*Balaenoptera musculus*), bowhead whale (*Balaena mysticetus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), northern right whale (*Eubalaena glacialis*), sperm whale (*Physeter macrocephalus*), and short-tailed albatross (*Phoebastria albatrus*). (U.S. Army Space and Missile Defense Command, 2002d) The recently delisted Aleutian Canada goose (*Branta canadensis leucopareia*) can occur in the area during migration. Several bird species that nest on Aleutian Islands include the mallard (*Anas platyrhynchos*), pelagic (*Phalacrocorax pelagicus*) and red-faced cormorant (*Phalacrocorax urile*), common eider (*Somateria mollissima*), bald eagle (*Haliaeetus leucocephalus*), Arctic (*Sterna paradisaea*) and Aleutian tern (*Sterna aleutica*), marbled murrelet (*Brachyramphus*

marmoratus), and tufted puffin (*Fratercula cirrhata*). (U.S. Army Space and Missile Defense Command, 2003)

Environmentally Sensitive Habitat

Wetlands are typical of the Arctic Tundra. Lack of oxygen in the waterlogged soil of wetlands and cold ground temperatures delay the decomposition of plant and animal matter and limit productivity. Poor drainage of the underlying permafrost soils results in a build-up of organic materials, such as peat and humic substances, which tend to color the water brown. The amount of water in the ground also influences what will grow in a particular wetland. There are five basic types of wetlands found in the Arctic Tundra: bogs, fens, swamps, marshes, and shallow open water. Bogs and fens are the most common in this region.

Ecological reserves and wildlife refuges are found throughout the Arctic Tundra region. For example, the Arctic National Wildlife Refuge is the largest wild land unit in the U.S. National Wildlife Refuge System. The refuge consists of an intact, naturally functioning community of arctic and sub-arctic ecosystems. Such a broad spectrum of diverse habitats occurring within a single protected unit is unparalleled in the circumpolar north. The refuge also is an important part of a larger international network of protected arctic and sub-arctic areas. Exhibit H-1 shows the landscape of the refuge.

Exhibit H-1. Arctic National Wildlife Refuge

Source: USFWS, 2000

Two Aleutian sites and their waters (including submerged lands), Shemya Island and Adak Island, are part of the Alaska Maritime National Wildlife Refuge. Shemya Island also is part of the National Wildlife Refuge System. In addition, the USFWS has indicated that the Upper, Middle, and Lower Lake system of Shemya is of interest for its ability to support migratory birds and provide a resting place. Asian birds, not observed elsewhere in the U.S., are often blown off course during migration by storms and appear

to be attracted by the airfield lights located in the vicinity of the lakes at Eareckson Air Station. (U.S. Army Space and Missile Defense Command, 2002d)

Protection of wildlife and natural resources is a concern throughout the Arctic Tundra, including international territories. The Conservation of Arctic Flora and Fauna, a working group of the Arctic Council, aims to conserve arctic biodiversity and to ensure that the use of arctic living resources is sustainable. The purpose of the Arctic Council, which consists of eight arctic countries, namely Canada, Denmark (which administers Greenland), Finland, Iceland, Norway, Sweden, the U.S., and the Russian Federation, is to provide a policy forum for discussion of environmental and sustainable development issues of common concern to the arctic-rim countries. The Conservation of Arctic Flora and Fauna advises the arctic governments on conservation matters and sustainable use issues of international significance and common concern.

Disturbance caused by boats or aircraft usually is controlled by distance or altitude regulations in protected areas and advisory restrictions elsewhere. Sometimes boat activities, such as the use of horns, are restricted. Exhibit H-2 provides examples of distance/altitude restrictions currently in place in some Arctic countries. Canada, Greenland, and the U.S. restrict the distance boats can approach breeding seabirds, but restrictions apply only to specific protected areas. Distance restrictions range from 15 meters (49 feet) for unmotorized boats in some reserves within Newfoundland, Canada to 1,600 meters (5,250 feet) in reserves in the U.S.

Arctic countries restrict the altitude below which aircraft cannot fly over a seabird colony. In general, minimum altitudes are in the range of 300-500 meters (984-1,640 feet) but are higher over some reserves in the U.S. (700 meters [2,300 feet]). Canadian flight manuals advise a minimum altitude of over 600 meters (2,000 feet) when flying over bird concentrations. In Greenland, advisory rules are in place restricting disturbance to wildlife caused by mineral resource exploration and extraction (directed mainly at helicopters).

Exhibit H-2. Regulation of Activities Near Seabird Colonies in Arctic Regions

Country	Closest Approach Distance by Boat	Boat Speed (maximum)	Aircraft Altitude (minimum)	Use of Boat Siren
	20 meters (66 feet) – motorized[1] 15 meters (49 feet) – non-motorized 100 meters (328 feet) or 50 meters (164 feet) off murre colonies	--	300 meters (984 feet) April 1 – September 1 in Newfoundland province reserves, most large colonies are marked on aeronautical charts	Not explicitly restricted but not allowed if disturbance to colony occurs
Greenland	500 meters (1,640 feet) for some protected colonies	18 kilometers per hour (11 miles per hour) [2]	500 meters (1,640 feet)	--
U.S.	100 – 1,600 meters (328 – 5,249 feet)	--	500 – 700 meters (1,640 – 2,297 feet)	--

Source: Modified from Chardine and Mendenhall, 2003

[1]Provincial regulation; Gull Island, Witless Bay- mixed Atlantic Puffin, Black-legged Kittiwake, Common Murre colony. Boat tour operators presently exempt

[2]Restriction in place for mineral exploration activities only

H.1.4 Geology and Soils

Geology

Geomorphic processes are distinctive in the Arctic Tundra, resulting in a variety of landforms. Under a protective layer of sod, water in the soil melts in summer to produce a thick mud that sometimes flows downslope to create bulges, terraces, and lobes on hillsides. The freeze and thaw of water in the soil sorts out coarse particles, giving rise to such patterns in the ground as rings, polygons, and stripes made of stones. The coastal plains have numerous lakes of thermokarst origin, formed by melting ground water. In some areas, a distinct tree line separates forest from the tundra. (Bailey, 1995)

Soils

Soil particles in the Arctic Tundra derive almost entirely from mechanical breakup of rock, with little or no chemical alteration. Continual freezing and thawing of the soil have disintegrated its particles. In the Arctic Tundra, the soil is very low in nutrients and minerals, except where animal droppings fertilize the soil. (Bailey, 1995) A matted accumulation of tundra peat is the predominant surficial soil on the Aleutian Islands.

This highly saturated material is typical of tundra regions. (U.S. Army Space and Missile Defense Command, 2002d)

Below the soil is the tundra's permafrost, a permanently frozen layer of earth. The majority of the Arctic Tundra Biome resides on a layer of permafrost. In the central and southern portions of the Arctic Tundra region, permafrost is discontinuous, absent on most southern exposures, and irregularly present adjacent to rivers and lakes. In more northern areas, the permafrost level may be two to four meters (six to 12 feet) deep. In the lowlands of the broad interior valleys, permafrost restricts drainage and accounts for the presence of extensive wetlands that form a complex of marshes, shrub thickets, small ponds, and forested islands.

During the short summers, the top layer of soil may thaw just long enough to allow plants to grow and reproduce. Water from melting permafrost and snow forms lakes and marshes each summer because the saturated ground cannot absorb any more water beneath its surface.

Geologic Hazards

Geologic hazards in the Arctic Tundra Biome include earthquakes, forest fires, volcanic activity, avalanches, and flooding. Volcanic eruptions in Alaska average one to two per year and significantly affect air transportation every three to four years.

Earthquake epicenters are scattered throughout the Arctic Tundra Biome, especially throughout the Aleutian Islands. The Aleutians extend nearly 1,900 kilometers (1,180 miles) from the tip of the eastern Alaskan Peninsula to the western tip of Attu Island. The island arc is the product of the convergence of the Earth's crustal plates, formed when the massive Pacific plate was forced downward beneath the Bering Sea plate. This rupturing of the Earth's crust is characterized by extreme tectonic activity, frequent earthquakes, and extensive volcanism. Of the 76 volcanoes throughout the Aleutians, about 40 have been active in the last 250 years. (USGS, 1999)

For example, Shemya Island falls within seismic zone 4, which reflects the highest hazard potential for earthquakes and severe ground shaking. Eareckson Air Station also is susceptible to tsunamis (tidal waves) resulting from earthquake ground displacements and earthquake triggered submarine landslides. (U.S. Army Space and Missile Defense Command, 2002d)

H.1.5 Hazardous Materials and Hazardous Waste

Hazardous Materials

Installations where MDA activities for the proposed BMDS may occur may store and use large quantities of hazardous materials, including a variety of flammable and combustible liquids. Hazardous materials stored at these installations may include fuels, antifreeze, paints, paint thinners and removers, adhesives, lead-acid batteries, nickel-cadmium batteries, plating solution, epoxy primer, lubricants, solvents, pesticides, and sodium dichromate. Materials used for boat, vehicle, and aviation repair; power and heat generation; wastewater treatment; photo processing; and building maintenance also are common. Fuels may include aviation gasoline, motor gasoline, and diesel fuel. Fuels can be transported to the sites via pipeline, truck, rail, or aircraft.

Procedures for managing hazardous materials are developed to establish standard operating procedures for the correct management and storage of hazardous materials at installations. Hazardous material inventories are regularly reviewed and updated as needed. Due to the extreme climate, special measures may be necessary for storage and handling of hazardous materials in arctic areas.

Hazardous Waste

Hazardous wastes generated at MDA installations where activities for the proposed BMDS may occur typically are associated with equipment maintenance. Wastes generated by the facility include oils, fuels, antifreeze, paint, paint thinner and remover, photo chemicals, pesticides, aerosol canisters, batteries, used acetone, sulfuric acid, and sewage sludge. Procedures are developed for managing hazardous wastes at sites where activities for the proposed BMDS may occur. The procedures include details necessary for maintaining compliance with U.S. and international regulations when handling hazardous waste.

Aboveground storage tanks with a range of capacities may be present at specific sites. The tanks and any supporting equipment are periodically inspected using visual inspection, hydrostatic inspection, or a system of nondestructive shell thickness testing. Protection of the contents of aboveground storage tanks from the extreme climate of the Arctic Tundra Biome is necessary. Sites where activities for the proposed BMDS may occur also may have underground storage tanks with a range of capacities. However, underground storage tanks are not likely to be found in areas where permafrost occurs.

H.1.6 Health and Safety

All activities associated with the proposed BMDS would comply with Federal, state, and local laws and regulations applicable to worker and environmental health and safety. All

sites where activities for the proposed BMDS may occur have established safety plans for various operations and accident scenarios, including the range; region; ordnance management; ocean area; fire and crash; rocket propellant and motor exhaust constituents; electromagnetic radiation (EMR); communications-electronics frequency; ESQD arcs; and sea range concerns. These safety plans are coordinated with the appropriate local governments.

The MDA would take every reasonable precaution during the planning and execution of the operations, training exercises, and test and development activities to prevent injury to human life or property. Potential hazards from explosive devices, physical impact, EM hazards, chemical contamination, ionizing and non-ionizing radiation, and lasers are considered in the safety plans. (U.S. Department of the Navy, 1998)

Where applicable, warning areas are established in international airspace and waters to contain activity that may be hazardous, and to alert pilots and captains of nonparticipating vessels to the potential danger. NOTAMs and Notices to Mariners (NOTMARs) are published and circulated in accordance with established procedures to provide warning to pilots and mariners (including recreational users of the space) that outline any potential impact areas that should be avoided.

Launch complexes and impact areas are generally located in remote areas often on military installations or ranges. Launches generally do not overfly areas where the majority of site personnel are located. Mission-essential personnel are instructed in safety procedures and equipped with necessary safety devices such as hearing protection. A launch can proceed only after all required safety evacuations have been accomplished to ensure that no unauthorized personnel are present in hazardous areas. Flight safety procedures include determining the dimensions of the safety zone surrounding the launch and impact area; identifying areas of the site that are evacuated for each mission; and activation of the FTS in the event of missile failure. Areas that are exposed to debris should be evacuated even though risk may be considered minimal.

Health and safety procedures should be available in site-specific operating documents.

H.1.7 Noise

Eareckson Air Station is a representative location where activities for the proposed BMDS may occur in the sparsely populated Arctic Tundra Biome. Eareckson Air Station is located on Shemya Island, which has no population other than personnel associated with the air station, and would be expected to have a background noise level of day/night average sound level (L_{dn}) less than or equal to 55 dBA. Shemya Island is quiet due to the prevailing winds, and aircraft noise is heard only when standing next to the airfield. The closest civilian community is approximately 604 kilometers (375 miles) from Shemya Island. (U.S. Army Space and Missile Defense Command, 2000)

The principal sources of noise from missile defense operations are vehicular traffic and military activities, including aircraft operations, rocket testing, and rocket launches. Frequency and duration of noise from military activities vary as a factor of the irregular training schedules, and noise levels vary with the type of activities at these facilities. Sonic booms are experienced near some of these facilities. Facilities that generate high outdoor noise levels have established programs with the goal of ensuring compatibility with land uses in the vicinity of these facilities. Examples of these programs are the Air Installation Compatible Use Zone program for DoD air installations and the Installation Compatible Use Zone program for Army installations and facilities. (BMDO, 1994)

Noise from missile defense activities, while intermittent, can be fairly loud. For example, noise from weapons testing typically ranges from 112 to 190 dBA. The noise levels on the ground from a helicopter at 460 meters (1,500 feet) and 76 meters (250 feet) of altitude are 79 dBA and 95 dBA, respectively. Maintenance equipment, such as the tracked vehicles used for trail maintenance, can generate noise levels up to 105 dBA. Aircraft noise occurs during aircraft engine warm-up, maintenance and testing, taxiing, takeoffs, approaches, and landings.

Generally, sites where activities for the proposed BMDS may occur are located far from towns and population centers and are surrounded by open space.

Ambient noise levels have the potential to impact wildlife resources. Because there are no absolute standards of short-term noise impacts to potentially noise-sensitive species, a short-term maximum noise exposure of 92 dB has been suggested as a significance cut-off for impacts. (U.S. Army Space and Missile Defense Command, 2002c) Measurements of ambient sound levels should be analyzed in site-specific environmental documents.

H.1.8 Transportation

Ground Transportation

Roadway travel in the Arctic Tundra Biome is generally limited due to the vast, undeveloped terrain. Highways decrease as one moves northward. Especially in the Arctic Tundra, roads between towns may be nonexistent. The quality of roads also varies greatly. Many roads in developed areas are two lanes and paved, however, some roads in remote areas may be unpaved and covered with dirt or gravel.

Due to the limited number of roadways, the traffic volume in sparsely populated areas tends to be greater than the volume experienced in urban areas. The summer months experience the highest amount of traffic, due to tourism and good weather.

Ground transportation also includes railway systems. The Arctic Tundra Biome includes systems that provide freight, passenger, and intermodal transportation across North

America, as well as regional and local service railways. Some rail lines, especially those located in northern regions of this biome, pass through scenic areas such as fjords, national parks and forests, mountains, and historic rivers.

Given the vast area of the Arctic Tundra Biome and the limited road network, aircraft provide an alternate means of transportation. Private and military aircraft comprise a large portion of air traffic in this region. Helicopters serve many domestic routes; especially where towns lack airstrips and ground transportation is not available. Chartered airplanes often are used for passenger service.

Air Transportation

Given the vast area of the Sub-Arctic Taiga Biome and the limited road network, aircraft provide an alternate means of transportation. Private and military aircraft comprise a large portion of air traffic in this region. Helicopters serve many domestic routes; especially where towns lack airstrips and ground transportation is not available. Chartered airplanes often are used for passenger service.

Marine Transportation

Marine travel tends to be limited in the Arctic Tundra Biome due to glacial patches found throughout many waterways. Transit operations in the arctic ice have proven hazardous to many large vessels in the past, especially cargo and merchant ships. The use of air transportation for cargo has alleviated the need for sea transportation in the Arctic. However, both local residents and tourists visiting this northern environment commonly rely on marine transportation. Small commercial vessels are used primarily for ferry passenger service and fishing activities and often are limited to designated waterways.

H.1.9 Water Resources

Surface Water and Ground Water Resources

In the Arctic Tundra, alluvial deposits are the principal aquifers for ground water, which is greatly restricted by permafrost. When under pressure from frost, ground water may burst to the surface in places, forming conical hills of mud and debris called pingos.

The Arctic Tundra Biome is characterized by permafrost, or ground that is permanently frozen. Because the permafrost has no cracks or pores, water is unable to penetrate it. There is little to no surface water in winter. During the summer, the surface layer above the permafrost, known as the active layer, thaws. The thickness of the active layer depends on its location in the tundra; the active layer becomes thinner in more northerly locations. As a result, during the summer, the Arctic Tundra is characterized by large quantities of surface water. When snow melts, the water percolates through the active

layer but is unable to penetrate the permafrost. Pools of water form on the surface, and the active layer becomes saturated. The thawing permafrost creates wetland conditions, dotting the landscape with countless lakes, bogs, streams, and meadows. Surface waters in the Arctic Tundra tend to be acidic and rich in organic material. In addition, glaciers are present throughout the Arctic Tundra region.

Different types of streams may be found throughout the Arctic Tundra. Glacier streams are fed from glacier melt water. While glacier-fed streams have moderate nutrient levels, which are supplied by subsurface runoff of the melt water, they also have very high sediment loads. The sediment is made up of fine rock particulates called glacial "flour." This suspended sediment blocks light and scours the stream bottom. Glacier-fed streams also have highly variable discharge and water temperature on a diurnal cycle and are high gradient streams with unstable substrate. These factors inhibit the colonization of substantial amounts of algae and insects, leading to low biodiversity.

Tundra streams have clear water that is often stained light brown with organic matter from the tundra. Many nutrients are locked within the permafrost, although there may be pulses of high nutrient levels during the spring runoff. The low gradient and generally stable flows of most tundra streams allow for the colonization of benthic algae and insects. However, a short growing season and the lack of phosphorus limit substantial algal accumulation.

Water Quality

Surface water and ground water quality is generally good in the Arctic Tundra Biome except in isolated areas of known contamination.

Although soils in the Arctic Tundra Biome are strongly acidic, pH of regional surface waters in North America is around 7, ranging from 6.8 to 7.5 in streams and 7.1 to 7.3 in lakes. The relatively high pH and capacity of streams and lakes to buffer acid inputs from natural and man-made sources are presumed to be the result of ions (e.g., calcium and magnesium) that have been carried into the atmosphere with sea spray and subsequently returned in rainfall. This is a common occurrence in coastal maritime regions. (Wetzel 1975, as referenced in FAA, 1996)

H.2 Sub-Arctic Taiga Biome

The Sub-Arctic Taiga Biome discussion focuses on the sub-arctic regions of North America, including portions of Alaska. This biome is generally located between latitudes 50 and 60 degrees north (see Figure 3-12). The sub-arctic climate zone coincides with a great belt of needleleaf forest, often referred to as boreal forest, and with the open lichen woodland known as taiga. Existing inland sites found in Alaska in the Sub-Arctic Taiga

Biome include Fort Greely (which includes Delta Junction), Clear Air Force Station, Eielson AFB, and Poker Flat Research Range.

Coastal sites also are located in the Sub-Arctic Taiga Biome, including portions of southwestern and western Alaska. Coastal sites are influenced by the cool climate generated by the cold waters of the North Atlantic Ocean and share maritime characteristics. Existing coastal sites where proposed BMDS activities may occur are found in Alaska in the Sub-Arctic Taiga Biome and include the KLC and Port of Valdez.

H.2.1 Air Quality

Climate

The climate of the Sub-Arctic Taiga Biome shows great seasonal range in temperature and rapid seasonal changes. Winters are severe and the cold, snowy forest climate remains moist all year, with cool, short summers. The average temperature is below freezing for six months out of the year. Winter is the dominant season and the temperature range is -54°C to -1°C (-65°F to 30°F). All moisture in the soil and subsoil freezes solidly to significant depths because average monthly temperatures remain subfreezing for six to seven consecutive months. Summers are mostly warm, rainy, and humid, and temperatures range from –7°C to 21°C (20°F to 70°F). Summer warmth is insufficient to thaw more than the surface, so permafrost prevails under large areas. Seasonal thaw penetrates from 0.6 to four meters (two to 14 feet), depending on latitude, aspect, and kind of ground. Altitude strongly influences the presence and extent of permafrost.

The total precipitation in a year is 30 to 85 centimeters (12 to 33 inches), which may fall as rain or snow or accumulate as dew. Most of the precipitation in the taiga falls as rain in the summer. Fire is a natural feature of the ecology of this biome. Early summer is often dry with an increased risk of fires, which are caused primarily by lightning.

Coastal locations in the Sub-Arctic Taiga Biome have a marine phase of the tundra climate, which is characterized by long, cold winters and short, cool summers. Maritime tundra dominates throughout southwestern and western Alaska and is the product of the cool climate generated by North Atlantic Ocean waters. The Arctic Ocean, which receives relatively warm north-flowing currents from the Atlantic and Pacific, acts as a moderating influence on the climate of the maritime tundra. Annual temperature ranges are much smaller in the marine phase than other sub-arctic regions. Winters are milder, and annual precipitation is greater. The average January temperature is about 16°C (3°F), and average temperatures in July are below 10°C (50°F). Fairly heavy snowfall occurs in winter and heavy concentrations of rain occur in summer. Average annual precipitation is about 46 centimeters (18 inches), and average annual snowfall ranges from 100 to 200 centimeters (39 to 78 inches).

Surface winds along the coast are much stronger and more persistent than at inland areas. For example, on Kodiak Island, while winds tend to be from the northwest at about 19 kilometers (12 miles) per hour, high winds occur throughout the year. Peak gusts range from 56 kilometers (35 miles) per hour in June to 134 kilometers (83 miles) per hour in December. Typically one day of heavy fog occurs per month, with visibility of 0.4 kilometer (0.25 mile) or less. The largest monthly snowfall occurs during December and January, with the maximum snowfalls ranging from 100 to 110 centimeters (40 to 45 inches) per month. (U.S. Army Space and Missile Defense Command, 2003)

Regional Air Quality

Air quality in the Sub-Arctic Taiga Biome generally is considered favorable; however, some areas in and around urban centers, such as Anchorage and Fairbanks are in non-attainment for CO concentrations, as designated by the U.S.

The primary pollutant of concern from mobile sources in Alaska is CO. According to Fairbanks North Star Borough studies, approximately 90 percent of all CO produced within the borough is from vehicles. (U.S. Army Space and Missile Defense Command, 2002d) During episodes of cold winter weather, atmospheric inversions may trap contaminants and cause exceedances of the NAAQS or state standards. Vehicle "cold starts" during moderately cold weather, prolonged idling periods, and low-level temperature inversions contribute to pronounced air quality impacts from motor vehicle emissions in cold climates. For example, up to 80 percent of CO emissions contributing to exceedances of the NAAQS in Fairbanks have been attributed to mobile sources. Other pollutants from mobile sources include hydrocarbons, NO_X, and particle emissions. (U.S. Army Space and Missile Defense Command, 2002d)

Mixing heights (altitudes at which pollutants and atmospheric gases are thoroughly combined) in the Sub-Arctic Taiga Biome adversely affect regional air quality and vary greatly depending on atmospheric conditions. The mixing height is generally highest during afternoon hours and lowest during the evening and early morning. However, temperature inversions, which occur most often in the winter, may cause extended periods of low mixing heights. Low mixing heights adversely affect regional air quality. For example, mixing heights in the taiga may range from 198 meters (650 feet) on winter mornings to 604 meters (1980 feet) on summer afternoons.

Existing Emission Sources

Emissions from activities for the proposed BMDS include CO, NO_x, SO_x, VOCs, hazardous air pollutants (HAPs), and particulate matter (PM). In coastal areas, wind-blown volcanic dust is the primary air contaminant. Major emissions sources associated with activities for the proposed BMDS in the Sub-Arctic Taiga Biome would include boilers, engines, hush houses, gas stations, fuel handling, chemicals, generators, storage

tanks, miscellaneous equipment, and prescribed burning/firefighter training. Most sites where activities for the proposed BMDS may occur would be classified as a major emissions source. Sites where activities for the proposed BMDS may occur maintain, or have submitted an application for, Title V Air Permits. For example, Clear Air Force Station operates under a Title V Air Permit. (U.S. Army Space and Missile Defense Command, 2002d)

H.2.2 Airspace

Controlled and Uncontrolled Airspace

Airspace above U.S. military airfields in the Sub-Arctic Taiga Biome generally includes controlled airspace and operates under IFR. In positive controlled areas, aircraft separation and safety advisories are provided by air traffic control centers. In general controlled airspace, operations may be either under IFR or VFR, and traffic advisories may be provided to aircraft operating under VFR. In uncontrolled airspace, operations may be under VFR or IFR, but no air traffic control is provided.

Alaskan airspace is located within the Anchorage Oceanic Control Area/Flight Information Region and within the U.S. Alaskan Air Defense Identification Zone. The Anchorage Air ARTCC controls Alaskan airspace. Communication and radar products are sent and received at the Anchorage Center via satellite, ground, and microwave transmitters and receivers. Due to the mountainous terrain, many areas have marginal to no communications and may lack radar coverage. The publication *Flight Tips for Pilots in Alaska* provides information to pilots flying to and within Alaska. It should be used in addition to the current Alaska Supplement, Sectional Aeronautical Charts, World Aeronautical Charts, Airmen's Information Manual, current NOTAMs, and current weather briefings.

Special Use Airspace

Alaska has some of the largest MOAs in the world. Much of Alaska's aviation activity takes place within existing MOAs, through a shared-use agreement, with information provided by the Special Use Airspace Information Service, which is a system operated by the USAF under agreement with the FAA Alaskan Region to assist pilots with flight planning and situational awareness while operating in or around MOAs or Restricted Areas in interior Alaska. Special use airspace designations typically are coordinated with airspace users through existing protocols for the site where activities for the proposed BMDS may occur, commercial aircraft carriers, and military aircraft. In addition, military facilities may have missile-firing ranges, drop zones, air-to-ground training weapons ranges, ammunition storage areas, and restricted areas. Pilots are advised to avoid overflight of such areas.

Airports/Airfields

There are over 650 civilian, military, and private airports registered with the FAA and more than 3,000 airstrips in Alaska. Most of the airports are owned and operated by the State of Alaska and certified by the FAA. However, many airports are private and not maintained on a regular basis. As a result, runway conditions may not be favorable at some airport locations. Existing military airfields, which have runways that are paved and in good condition, would be used to support activities for the proposed BMDS.

En Route Airways and Jet Routes

Civilian aircrafts generally fly along established flight corridors that operate under VFR. Numerous Minimum En route Altitudes are present in Alaska. Minimum En route Altitudes from 2,400 to 4,000 meters (8,000 to 13,000 feet) are common throughout the state, and in some areas they can be as high as 7,000 meters (23,000 feet).

H.2.3 Biological Resources

Vegetation

The vegetation of the Sub-Arctic Taiga Biome is primarily boreal forest, which is a complex array of plant communities shaped by fire, soil temperature, drainage, and exposure. Forest types are mixed and species composition is determined by steepness of slopes, aspects (the cardinal direction a slope faces), and fire histories. Natural wildfires, which are a critical component of the boreal forest biome, occur about every 50 to 70 years. Vegetation at and near sites where activities for the proposed BMDS may occur located in interior Alaska is typical of boreal forest regions.

The boreal forest is a transition zone of scattered coniferous or evergreen trees and shrubs, which are mixed with tundra vegetation. The most common trees are balsam fir, spruce, and larch. The conifers of the boreal forest are white spruce (*picea glauca*), which are found on well-drained floodplain soils, uplands, and south-facing slopes where seasonal thaw is deep. Black spruce (*Picea mariana*) grows in lowlands and on north-facing slopes where the annual thaw is shallow and permafrost is close to the surface. A broad-leaved deciduous forest of quaking aspen (*Populus tremuloides*), balsam poplar (*Populus balsamife*ra), and Alaska paper birch (*Betula neoalaskana*) is prominent on well-drained uplands, whereas floodplain forests are composed of balsam poplar, white spruce, paper birch mixed with mountain alder (*alnus tenuifolia*) and several species of willow. White birch, (*Betula papyrifera*) one of the few deciduous trees able to withstand the cold climate, also is found in this region. There is little precipitation and a short growing season. The stunted and slow-growing trees often are of little use to humans.

Rocky areas in the central part of the boreal forest region contain small trees but little other vegetation. The rest of this region is covered mainly with lakes and swamps called muskegs. Dense growths of spruce and tamarack (*Larix laricina*) are found around the edges of muskegs while many shrubs and cranberries (*Vaccinium oxycoccus*) grow near the center.

In coastal regions, plant life is transitional between the Arctic Tundra and Sub-Arctic Taiga regions. Lava fields of recent origin provide unusual sites for plants. Groves of balsam poplar and other boreal forbs and ferns, which are common in the boreal forest but unusual here, occur in the immediate vicinity of hot springs, presumably because soils are suffused with warm mineral waters. Clusters of pingos and thermokarst lakes (sites of erosion and subsidence by thawing of permafrost) occur in the interior lowlands, which were formed by large rivers, and also may occur in association with isolated groves of balsam poplar where other trees are absent. In the sedge-graminoid meadows where flooding occurs, important taxa include the Ramenski sedge (*Carex ramenski*), loose-flowered alpine sedge, Lyngby sedge (*Carex Lyngbyei*), reedgrass, forbs silverweed cinquefoil, and low chickweed (*stellaria media*).

Sandy beaches are common in the maritime areas, some of which are associated with dune fields. Mudflats support open communities of halophytic plants that are adapted to a saline environment and include grasses, sedges, and forbs such as creeping alkaligrass *(Puccinellia phryganodes),* Hoppner sedge *(Carex subspathacea),* sea-beach sandwort *(Honkenya peploides),* and oysterleaf *(Mertensia maritime).* The sandy beaches are dominated by beach ryegrass *(Elymus arenarius)* and forbs such as beach pea and seaside ragwort *(Senecio resedifolius).* In places where dunes formed, strong floristic differences exist between plants on prominences and those in depressions, and between plants on dunes and those on backslopes.

On numerous sites where activities for the proposed BMDS may occur, native vegetation has been removed, and the land is landscaped and maintained by mowing and brush control measures. Isolated pockets of vegetation may remain on sites where activities for the proposed BMDS may occur, however, vegetation on off-site areas is widespread and may be undisturbed.

Wildlife

The interior areas of the Sub-Arctic Taiga Biome are populated with unique animals that have techniques for preserving warmth and staying dry. Animals of the taiga tend to be predators such as the lynx and members of the weasel family such as wolverines, bobcats (*Lynx rufus*), minks (*Mustela vison*), and ermine (*Mustela erminea*), which hunt herbivores such as snowshoe rabbits, red squirrels (*Tamiasciurus hudsonicus*), and voles. Red deer (*Cervus elaphus*), elk (*Cervus Canadensis*), and moose (*Alces alces*) can be found in regions of the taiga where more deciduous trees grow. Many insect-eating birds

come to the boreal forest to breed and leave at the end of the breeding season. Seed-eating birds, such as finches and sparrows, and omnivorous birds, such as crows, are present year-round. The wildlife at sites where activities for the proposed BMDS may occur in interior Alaska is typical of the fairly undisturbed nature of the surrounding taiga.

Fish species that occur in the freshwaters of the taiga include chinook (*Oncorhynchus tshawytscha*), chum, and coho salmon; rainbow trout (*Salmo gairdneri*); sheefish (*Stenodus leucichthys*); humpback (*Coregonus clupeaformis*) and round whitefish (*Propopium cylindraceum*); least cisco (*Coregonus sardinella*); Arctic grayling (*Thymallus arcticus*); lake trout; northern pike (*Esox lucius)*; and burbot. Adaptations of fish species to different systems or to different parts of the same system have sometimes caused complex migrations to overwintering, spawning, and feeding sites. Large numbers of breeding waterfowl summer on wetlands of the boreal forest, and thousands more pass through this region during migration. The region is important for trumpeter swans (*Cygnus buccinator*) and tundra swans (*Cygnus colombianus*), canvasbacks (*Aythya valisineria*), and greater white-fronted geese (*Anser albifrons*). Bald eagles (*Haliaeetus leucocephalus*) that breed along major river systems have maintained relatively stable populations. The recently delisted American peregrine falcon (*Falco peregrinus anatum*) and arctic peregrine falcon (*Falco peregrinus tundrius*) migrate through the area during the spring and fall migration periods. Four other species are of special concern because of declining population trends throughout North America: the olive-sided flycatcher (*Contopus borealis*), gray-cheeked thrush (*Catharus minimus*), Townsend's warbler (*Dendroica townsendi*), and blackpoll warbler (*Dendroica striata*). (USGS, 1999)

In coastal areas of the Sub-Arctic Taiga Biome, the freshwaters include fish species such as the sheefish, whitefishes, Arctic grayling, Arctic char (*Salvenlinus alpinus*), Dolly Varden (*Salvelinus malma Walbaum*), rainbow trout, northern pike, Alaska blackfish (*Orcinus orca*), and five salmon species (sockeye, coho, chinook, chum, and pink). In some coastal areas, freshwaters are subject to severe freezing in winter, making springs important to the overwinter survival of freshwater fishes. The region's spawning (anadromous) and freshwater resident fishes and their eggs provide food for a diversity of mammals, birds, and other fishes.

All estuarine and marine areas out to the Exclusive Economic Zone of the U.S. used by Alaskan Pacific salmon are designated as Essential Fish Habitat for salmon fisheries. Salmon occur in the Prince William Sound mainly from June through September as they return from the ocean to spawn. Essential Fish Habitat also has been designated for scallops and Gulf of Alaska ground fish in the Port of Valdez. (U.S. Army Space and Missile Defense Command, 2003)

The coastal sub-arctic region supports large populations of brant *(Branta bernicla),* cackling Canada geese *(Branta canadensis minima),* emperor geese *(Anser canagicus),* and greater white-fronted geese *(Anser albifrons).* Birds of prey are relatively rare in this area, although the pealei subspecies of peregrine falcons *(Falco peregrinus pealei)* is common around seabird colonies. The large numbers of shorebirds that breed on coastal maritime tundra in western Alaska include the world's population of black turnstones *(Arenaria melanocephala)* and most of the world's population of bristle-thighed curlews *(Numenius tahitiensis).*

The mammalian fauna of this region is composed of shared elements from the boreal forest (muskrat [*Ondatra zibethicus*], northern red-backed vole [*Clethrionomys rutilus*], tundra vole [*Microtus oeconomus*], and red fox [*Vulpes vulpes*]) and from the Arctic Tundra (Greenland collared lemming [*Dicrostonyx groenlandicus*], Arctic ground squirrel [*Spermophilus parryii*], and Arctic fox [*Alopex lagopus*]). Species that have been absent from much of the area in the recent past include the moose, caribou, snowshoe hare (*Lepus Americanus*), lynx (*Felis lynx*), beaver (*Castor Canadensis*), coyote (*Canis latrans clepticus*), and gray wolf (*Canis lupus*), however, many of these species have begun to return to the maritime tundra region. (USGS, 1999)

Marine mammals with Federal or state status that may occur in the coastal areas of the Sub-Arctic Taiga Biome include the Steller sea lion, humpback whale *(Megaptera novaeangliae)*, Northern right whale, Sei whale *(Balaenoptera borealis),* blue whale *(Balaenoptera musculus),* fin whale, sperm whale, short-tailed albatross, and Steller's eider. For example, consistent and extensive use of the Kodiak area by the Steller's eider has been observed. Although critical habitat has not been designated in the Kodiak Archipelago, the area still contains important habitat for Steller's eiders and protection afforded by the Endangered Species Act still applies. Critical habitat for the Steller sea lion includes a special aquatic foraging area in the Shelikof Strait area consisting in part of an area between the Alaskan Peninsula and the western side of Kodiak Island. (U.S. Army Space and Missile Defense Command, 2002d)

Environmentally Sensitive Habitat

Wetlands in the U.S. support vegetation, provide habitat for fish and wildlife, and contribute to flood control and sediment retention. Palustrine, emergent, persistent, seasonally flooded and palustrine scrub/shrub, broad-leaved deciduous, saturated wetlands are located throughout the Sub-Arctic Taiga Biome. Most wetlands in the Sub-Arctic Taiga generally are classified as palustrine (non-flowing) or riverine, which occur alongside rivers and streams. The most common type of vegetated wetland is black spruce (*Picea mariana*) wetlands. On most wetlands in the sub-arctic region, wet soils result from poor drainage caused by permafrost.

Extensive deposits of sand and sand dunes were formed over some present-day boreal forest areas in the late glacial time. Forest cover stabilized many of these deposits, but others remain exposed along riverbanks and deltas. For example, the exceptional, extensive, active dune fields of the Great Kobuk Sand Dunes occur on the middle Kobuk River, where the wildflower Kobuk locoweed (*Oxytropis kobukensis*) is endemic, and on the Nogahabara Sand Dunes of the Koyukuk River, which is the sole Alaskan locality of the Baikal Sedge (*Carex sabulosa*), a sedge of desert-steppe landscapes in Asia. This species is known from North America only from similar habitats in a few localities in the southwestern Yukon Territory, Canada. These unique landscapes and their plant complexes are protected because they are located in national parks or national wildlife refuges. (USGS, 1999)

Steppe vegetation can be located and defined by its south-facing topographic aspect. The steepest portions of slopes are generally treeless, presumably because of drought and geomorphic instability. Each steppe site can be thought of as a small island in a sea of forest. The steppe bluffs are characterized by rare plant taxa. The vascular plants of these steppe bluffs, for example, the disjunct species American alyssum (*Alyssum obovatum*) and the wormwood *Artemisia laciniatiformis*, occur only in the sub-arctic interior of Alaska and in the adjacent Canadian Yukon Territory. Researchers are exploring how these isolated plant communities became established on these bluffs and why they remain so restricted. (USGS, 1999)

Coastal areas of the Sub-Arctic Taiga support unique populations of freshwater fishes. These populations are considered to have intrinsic ecological values that reach beyond this region because they have not been genetically altered by releases of fishes from hatcheries and represent some of the only truly wild populations left in the world. (USGS, 1999)

H.2.4 Geology and Soils

Geology

High mountains, broad lowlands, diverse streams and lakes, and complex rock formations characterize the geology of the Sub-Arctic Taiga Biome. High mountains in inland areas shelter the interior from the moist maritime air that occurs in the south and the cold arctic air characteristic of the north. The uplift of foothills, advance and retreat of glaciers, and subsequent erosion by major drainages originating in the Alaska Range and foothills have provided the source for major sedimentary deposition throughout the Sub-Arctic Taiga Biome. Beaches, lagoons, and sandy sediments also characterize coastal areas.

Soils

The boreal forest grows on poorly developed soils with pockets of wet, organic histosols. These light gray soils are wet, strongly leached, and acidic; they form a highly distinct layer beneath a topsoil layer of organic matter. Agricultural potential is poor due to the natural infertility of soils and the prevalence of swamps and lakes left by departing ice sheets. In some places, ice has scoured rock surfaces bare. Elsewhere, rock basins have been formed and stream courses dammed, creating countless lakes. (Bailey, 1995)

Permafrost is mostly continuous in the northern portion of the boreal forest region, except in riverbeds, beneath lakes, and on steep, south-facing bluffs. Permafrost is permanently frozen soil, subsoil, or other deposit and is characteristic of arctic and some sub-arctic regions. Permafrost is a thermal condition in which the ground remains at a temperature below freezing, year-round. In permafrost regions, summers are only long and warm enough to thaw the surface of the ground, known as the active layer. In coastal areas, permafrost is generally absent or discontinuous.

Soils in the coastal areas are typically rocky, organic, or volcanic. These soils support tall brush, grass, and some moist tundra at higher elevations and coastal spruce on lower slopes. Limitations on types of vegetation are due not only to soil types but also to land slopes. Soils in the maritime region are formed in ash deposits of various thicknesses and are underlain by glacial gravel or silty sediments. Coastal plain soils are formed in gravels, cinders, or weathered rock blanketed by thick sedge peat. Permafrost is sporadic or absent. The maritime taiga is characterized by poor drainage of surface water.

Geologic Hazards

Geologic hazards in the Sub-Arctic Taiga Biome include earthquakes, forest fires, volcanic activity, avalanches, and flooding. Volcanic eruptions in Alaska average one to two per year and significantly affect air transportation every three to four years. The coastal regions of the taiga are subject to ash falls from active volcanoes in the Aleutian chain. Over 40 volcanoes are active in the Aleutian arc.

Earthquake epicenters are scattered throughout the interior Sub-Arctic Taiga Biome. For example, portions of Alaska are located in Seismic Zone 3, a northeast-trending band of seismic activity, where major earthquake damage has a ten percent probability of occurring at least once in 50 years. An average of five or six earthquakes a year is actually felt in this zone. In June 1967, a series of three earthquakes of about magnitude six had epicenters in this seismic zone. In November 2002, the Denali Fault earthquake occurred on the Denali-Totschunda fault system with a magnitude of 7.9.

H.2.5 Hazardous Materials and Hazardous Waste

Hazardous Materials

Installations where activities for the proposed BMDS may occur may store and utilize large quantities of hazardous materials, including a variety of flammable and combustible liquids. Hazardous materials stored at these installations in the Sub-Arctic Taiga Biome may include fuels, antifreeze, paints, paint thinners and removers, adhesives, lead-acid batteries, nickel-cadmium batteries, plating solution, epoxy primer, lubricants, solvents, pesticides, and sodium dichromate. Materials used for boat, vehicle, and aviation repair; power and heat generation; wastewater treatment; photo processing; and building maintenance also are common. Fuels may include aviation gasoline, motor gasoline, and diesel fuel. Fuels can be transported to the sites via pipeline, truck, rail, or aircraft.

Procedures for managing hazardous materials are developed to establish standard operating procedures for the correct management and storage of hazardous materials at installations where activities for the proposed BMDS may occur. Hazardous material inventories are regularly reviewed and updated as needed.

Above- and underground tanks with a range of capacities may be present at specific sites. The tanks and any supporting equipment are periodically inspected using visual inspection, hydrostatic inspection, or a system of nondestructive shell thickness testing. Currently, Fort Greely has 49 aboveground storage tanks with capacities ranging from 946 to 2,384,809 liters (250 to 630,000 gallons). There are 23 underground storage tanks at Fort Greely with capacities ranging from 1,136 to 189,270 liters (300 to 50,000 gallons). (U.S. Army Space and Missile Defense Command, 2002d)

The Port of Valdez, a coastal site in the Sub-Arctic Taiga Biome, serves as the southern terminal of the Trans-Alaska Pipeline System. This terminal occupies approximately 404.7 hectares (1,000 acres) of land owned by the Alyeska Pipeline Service Company. The terminal serves to store and load crude oil and houses the Operations Control Center for the Trans-Alaskan Pipeline System. The most prevalent hazardous material at the terminal is diesel fuel, with approximately 30 million liters (eight million gallons) nominally being stored at any given time. Other common materials include gasoline for equipment and vehicles, propane, organic solvents, heat transfer fluids, glycol-based coolants, refrigerants, protective coatings, fire suppression chemicals, and cleaning agents. (U.S. Army Space and Missile Defense Command, 2003)

Hazardous Waste

Hazardous wastes generated at specific installations where activities for the proposed BMDS may occur typically are associated with equipment maintenance. Wastes generated by the facility include oils, fuels, antifreeze, paint, paint thinner and remover,

photo chemicals, pesticides, aerosol canisters, batteries, used acetone, sulfuric acid, and sewage sludge. Procedures typically are developed for managing hazardous wastes at sites where activities for the proposed BMDS may occur. Installations may recycle non-hazardous waste that includes paper, cardboard, plastics, glass, and aluminum; however, recycling capabilities in Alaska are limited.

For example, the Valdez Marine Terminal is considered a large quantity generator. Hazardous waste would be generated from various routine and preventative maintenance and repair activities at the terminal. These wastes include spent thinners, cleaning solvents, flammable paints and coatings, corrosive acids, flammable adhesives, used oils containing chlorinated compounds, spent coolants, spent aerosol cans and crushed fluorescent lights. Sludge and residues removed from equipment and sumps also may be characterized as hazardous. The largest quantity of potentially hazardous waste would be from tank bottoms and "materials in process" that are periodically removed from equipment and storage tanks. Some spill debris and containment media also may be characterized as hazardous. (U.S. Army Space and Missile Defense Command, 2003)

H.2.6 Health and Safety

Health and Safety attributes of the Sub-Arctic Taiga Biome are similar to those discussed in Section H.1.6.

H.2.7 Noise

The Sub-Arctic Taiga Biome generally is sparsely populated and most of the region is expected to have a background noise level of L_{dn} less than or equal to 55 dBA. The KLC is representative of noise levels for sites where activities for the proposed BMDS may occur in the Sub-Arctic Coastal Biome. Ambient noise levels range from 70 dBA to 95 dBA. (DOT, 2001) Noise sources associated with the proposed BMDS are described in Section H.1.7.

H.2.8 Transportation

Ground Transportation

Roadway travel in the Sub-Arctic Taiga Biome is generally limited due to the vast, undeveloped terrain. Highways are found throughout the region and decrease as one moves northward. Roads between towns may be nonexistent. The quality of roads also varies greatly. Many roads in developed areas are two-lanes and paved, however, some roads may be unpaved in remote areas and covered with dirt or gravel.

Due to the limited number of roadways, the traffic volume in sparsely populated areas tends to be greater than experienced in urban areas. The summer months experience the highest amount of traffic due to tourism and good weather.

Ground transportation also includes railway systems. The Sub-Arctic Taiga Biome includes systems that provide freight, passenger, and intermodal transportation across North America, as well as regional and local service railways. Some rail lines, especially those located in northern regions of this biome, pass through scenic areas such as fjords, national parks and forests, mountains, and historic rivers.

Air Transportation

Given the vast area of the Sub-Arctic Taiga Biome and the limited road network, aircraft provide an alternate means of transportation. Private and military aircraft comprise a large portion of air traffic in this region. Helicopters serve many domestic routes, especially where towns lack airstrips and ground transportation is not available. Chartered airplanes often are used for passenger service. Kodiak Island, for example, currently supports C-130 aircraft and H-60 helicopters. Personnel and most types of equipment can be transported to Kodiak Island on daily flights offered by Alaska Airlines and ERA Aviation. (U.S. Army Space and Missile Defense Command, 2003)

Marine Transportation

Marine travel tends to be limited in the Sub-Arctic Taiga Biome due to glacial patches found throughout many waterways. Transit operations in the arctic ice have proven hazardous to many large vessels in the past, especially cargo and merchant ships. The use of air transportation for cargo has alleviated the need for sea transportation in the Arctic. However, both local residents and tourists visiting this northern environment commonly rely on marine transportation. Small commercial vessels are used primarily for ferry passenger service and fishing activities and often are limited to designated waterways.

For example, Kodiak Island offers a full range of dockage and marine services for commercial fishing, cargo, passenger, and recreational vessels. Large vessels, including the state ferry, cruise ships, and cargo vessels are moored at three deepwater piers. In the Prince William Sound area, marine transportation plays an important role, including its role in shipping petroleum products from the Valdez Marine Terminal. The Port of Valdez is equipped with the highest level of marine infrastructure, accommodating interstate and international cargo receipt and shipment. The Port of Valdez is an ice-free port with access to Interior Alaska, the U.S. Pacific Northwest, Northern Canada, and the Pacific Rim trade routes. (U.S. Army Space and Missile Defense Command, 2003)

H.2.9 Water Resources

Surface Water and Ground Water Resources

Ground water is supplied by nearby rivers, precipitation, and melt water in the Sub-Arctic Taiga Biome. The depth and amount of ground water fluctuates in response to changes in the seasons and weather. Ground water levels are highest in the late summer, when snow and ice melt is augmented by rainfall. The lowest levels generally occur in the fall, and a slow rise in winter levels is normal. Local variations in flow directions occur near surface water bodies and sources of ground water, such as melting snow.

Characteristic of the taiga are innumerable water bodies, including bogs, fens, marshes, shallow lakes, rivers and wetlands, which are intermixed among the forest and hold vast amounts of water. Creeks and ponds also are common throughout this biome. Many rivers in the boreal forest region are glacier-fed and silt-laden. The peak flow of these rivers is reached in late summer, when snow and ice melt is augmented by rainfall. Minimum flow occurs in winter when precipitation occurs as snow. Many bodies of water remain frozen during the winter. Permafrost is present only in patches, and during the summer, the unfrozen layer is generally thick. The water is often acidic and rich in organic material from the surrounding landscape. Because the ground has a limited ability to store water, the spring flood can be violent, undercutting the riverbank and causing extensive erosion along its path. Rainstorms also may cause high flows and floods, especially on small streams. The effects of floods and storms can be much less severe on rivers with large drainage basins.

Spring streams in the sub-arctic region derive water from underground sources. As a result, springs are rich in cations (positively charged particles that aid in uptake by plants) and nutrients, flow year-round, and have stable water temperatures. This provides a stable, enriched habitat for primary and secondary producers leading to high biomass and diversity of algae, moss, and insects.

In coastal areas, ground water is found primarily in river basins and recharged by infiltration of melt water from precipitation and glaciers. Ground water typically is derived from unconfined aquifers composed of sand and gravel. The coastal region generally consists of wet, saturated organic materials spread across flat lands, extensive areas of peatlands, swamps, streams, small lakes, and wetlands. Kettle lakes and lakes formed by glacial erosion are found in upland areas. Sea ice occasionally occurs in water formations. During high tides, marshes and lagoons that feed into the coastline may be subject to saltwater inundation.

Water Quality

Water quality for sites where activities for the proposed BMDS may occur in interior Alaska, such as Fort Greely and Clear Air Force Station, typically meets state drinking water standards. Water quality is subject to seasonal variations, but remains within established EPA drinking water standards. However, at Eielson AFB, background ground water quality analyses have shown that the average iron and manganese concentrations typically exceed the secondary maximum contaminant levels for drinking water. Arsenic has been identified as a constituent of concern at Eielson AFB, and one background sample exceeded the primary drinking water standard of 50 micrograms per liter. (U.S. Army Space and Missile Defense Command, 2002d) Water quality in the coastal areas of the Sub-Arctic Taiga Biome is generally good.

H.3 Deciduous Forest Biome

As shown in Exhibit 3-13, the Deciduous Forest Biome includes the deciduous forest regions of North America, which include most of the eastern portion of the U.S. and parts of central Europe and East Asia. The description in this section of the U.S. deciduous forest is representative of this biome throughout the world.

Existing inland sites in the Deciduous Forest Biome include Redstone Arsenal, Alabama; Fort Devens, Massachusetts; and Aberdeen Proving Ground, Maryland.

Coastal sites also are located in the Deciduous Forest Biome. These sites share maritime characteristics. Existing coastal sites include Naval Air Station Patuxent River, Maryland; Wallops Island, Virginia; Cape Canaveral Air Force Station, Florida; Cape Cod Air Force Station, Massachusetts; and Eglin AFB, Florida.

H.3.1 Air Quality

Climate

The average annual temperature in a deciduous forest is 10°C (50°F). The average rainfall is 76 to 152 centimeters (30 to 60 inches) a year, with nearly 36 centimeters (14 inches) of rain in the winter and more than 46 centimeters (18 inches) of rain in the summer. Humidity in these forests is high, ranging from 60 to 80 percent. Because of its location, air masses from both the cold polar region and the warm tropical region contribute to the climate changes in this biome.

Most deciduous forests have mild summers with temperatures averaging about 21°C (70°F). Winter temperatures are cool with an average temperature slightly below 0°C (32°F). The humid subtropical climate, marked by high humidity, especially in summer, and the absence of cold winters, prevails in the Southern Atlantic and Gulf Coast states.

Most deciduous forests are located near oceans. The ocean and wind are two key factors that determine the variability in temperature and climate changes in this ecological system. In the northern part of the deciduous forest, the frost-free or growing season lasts for three to six months.

In the coastal regions of the Deciduous Forest Biome, climate is influenced by three main air masses, the Continental Arctic, the Continental Polar, and the Maritime Tropical. The Continental Arctic air masses usually originate north of the Arctic Circle and plunge across Canada and the U.S. during winter. The Continental Arctic air masses have extremely cold temperatures and very little moisture. Continental Polar air masses form farther south and often dominate the weather in the U.S. during winter. During the summer, the Continental Polar air masses bring clear weather to the northeastern U.S. Continental Polar air masses have cold and dry air, but not as cold as Arctic air masses. Maritime Tropical air masses originate over the warm waters of the southern Atlantic Ocean and the Gulf of Mexico and can form year-round. Maritime Tropical air masses have warm temperatures with copious moisture and are responsible for the hot, humid summer across the South and the East.

The climate along the U.S. coast differs according to latitudinal location. Differences in climate in this region are characterized according to the Northern Atlantic states and the Southern Atlantic and Gulf Coast states. The coastal region is considered moist and rainfall decreases with distance from the ocean. Located squarely between the source regions of Continental Polar air masses to the north and Maritime or Continental Tropical air masses to the south, coastal areas of the northern states are subject to strong seasonal contrasts in temperature as these air masses push back and forth across the continent. (Bailey, 1995)

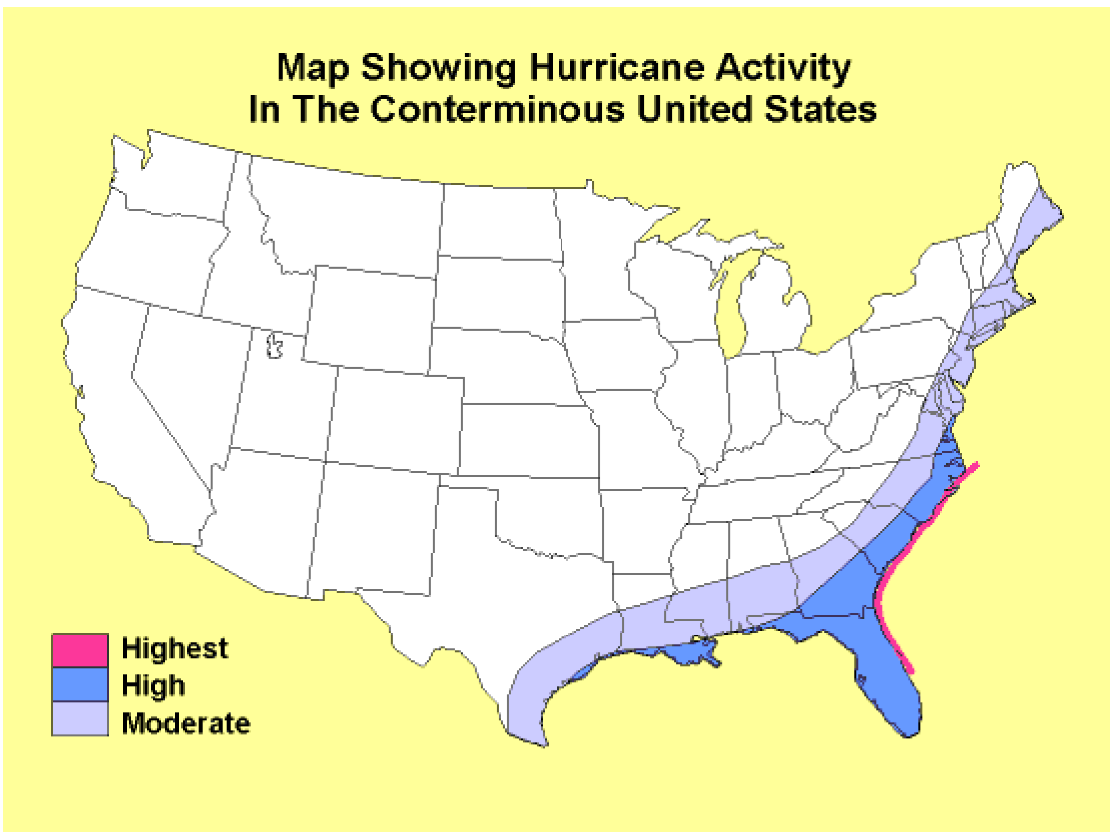
The humid subtropical climate, marked by high humidity, especially in summer, and the absence of cold winters, prevails in the Southern Atlantic and Gulf Coast states. The climate is temperate and rainy with hot summers. The climate has no dry season, and even the driest summer month receives at least 30 millimeters (1.2 inches) of rain. The average temperature of the warmest summer month is above 22 °C (72 °F). Precipitation is ample all year but is greatest during summer.

Winter precipitation, some in the form of snow, is of the frontal type. Temperatures are moderately wide in range and comparable to those in tropical deserts, but without the extreme heat of a desert summer. (Bailey, 1995)

Thunderstorms are frequent, especially in the summer, and may be thermal, squall line, or cold front in origin. Tropical cyclones or hurricanes strike the southern U.S. Atlantic coastal area occasionally, bringing heavy rains. Hurricanes form in the Atlantic basin to the east of the continental U.S. in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea. In the Atlantic coast region, hurricanes form anywhere from the tropical central

Atlantic to the Gulf of Mexico. Those that form in the central Atlantic and Caribbean region usually start off moving westward, then may curve towards and strike the North American mainland. Some storms that begin in the Gulf of Mexico may move pole-ward and eastward from their inception. Along the U.S. Atlantic and Gulf coasts, the Gulf Stream provides a source of warm waters (greater than 26.5°C [80°F]) to help maintain hurricane activity. Exhibit H-3 shows that the Deciduous Forest Biome in the U.S. is subject to significant hurricane activity.

Exhibit H-3. Hurricane Activity in the U.S.



Source: USGS, 2002e

The areas shown in Exhibit H-3 reflect the number of hurricanes per 100 years expected to pass within 159 kilometers (75 nautical miles) of any point in the shaded regions. The highest-risk area (the southern and Mid-Atlantic coast) shows where 60 hurricanes per 100 years skim up the east coast. The high-risk area would see 40-60 hurricanes per 100 years, and the moderate-risk area would see 20-40 hurricanes per 100 years. The period of observation was 1888 to 1988.

Regional Air Quality

Many metropolitan regions on the U.S. Atlantic Coast are in non-attainment for EPA's NAAQS for ozone, the primary constituent of urban smog. The EPA recently conducted a national-scale assessment of 33 air pollutants (a subset of 32 HAPs plus diesel PM), including sources, ambient concentrations, and human health risk (cancer and noncancer). Many of the highest-ranking 20 percent of counties in terms of risk are located in the Atlantic and Gulf coastal areas in Texas, Louisiana, Alabama, and coastal areas from northern Virginia to Maine. (EPA, 1996) For example, Cape Cod Air Force Station is situated within the Southeastern Massachusetts Air Quality Control Region, which is classified as serious non-attainment for ozone and attainment or unclassified for all other NAAQS. (U.S. Department of the Air Force, 2002)

The southern Atlantic coast from Virginia through Florida is in attainment for all criteria air pollutants. However, the entire coastal area from northern Virginia through Maine is in non-attainment for ozone (ranging from moderate to severe), and small areas in Connecticut are in moderate non-attainment for PM_{10}.

The air in the eastern Gulf of Mexico has very low concentrations of air pollutants. There are few emissions sources (air traffic, drilling platforms, surface vessel exhaust, transport phenomena), and while each of these sources individually has limited localized effects on air quality, their cumulative impact on overall Gulf of Mexico air quality has not been documented. (U.S. Department of the Air Force, 2002)

Air pollutants occasionally reach relatively high levels when strong ground-based temperature inversions trap pollutants near the ground. Many coastal areas experience inversions during the night. Although these inversions normally break during the morning due to surface heating, sometimes they persist for more than one day. In the Gulf region, on average there are five to seven days each winter during which the inversion does not break. Most often this is due to a deep layer of sea fog reducing the amount of surface heating. (U.S. Department of the Air Force, 2002)

For example, the atmosphere of the Eglin AFB area has a limited tolerance to high pollution because of the regular occurrence of inversions. It is, however, more capable of dispersing air pollutants than adjacent areas to the north but not so much that winter air pollution episodes could not occur. Low-velocity winds and inversion conditions contribute to short-duration, low-level concentrations of air pollution, especially in areas with high traffic concentrations. (U.S. Department of the Air Force, 1998a)

The meteorology and climatology of the Gulf Coast region are dominated by the western Gulf with extremes in humidity, precipitation, and coastal air mass movements. The Gulf Coast has an unusual mix of large industrial emission sources, extensive transportation emission sources, significant biogenic emissions, and a complex coastal meteorology.

These sources and the meteorology interact to produce high levels of ozone, HAPs, and fine PM. Ozone concentrations in areas of the region are among the highest in the nation.

Air quality throughout East Asia varies markedly. The region includes highly industrialized cities, such as Tokyo and Kyoto in Japan, with comparatively low air quality. Of Asian countries, Japan's average annual SO_2 emissions are the highest, at 0.26 milligrams per cubic meter (mg/m^3). By way of comparison, the average annual SO_2 emissions in China and the U.S. are 0.06 mg/m^3. There are many largely unpopulated rural areas in remote coastal areas of East Asia that are far less polluted. (World Bank, 2003a)

Existing Emission Sources

Sites where activities for the proposed BMDS may occur maintain, or have submitted an application for, Title V Air Permits. Many activities for the proposed BMDS would be located at existing facilities with emissions generated by automobile and other vehicular exhaust, airplane and rocket exhaust, and diesel-powered generator emissions. Some manufacturing facilities could be located in existing major manufacturing areas that are likely to be in non-attainment for one or more pollutants. Emissions from activities for the proposed BMDS include CO, NO_X, SO_X, VOCs, HAPs, and PM.

Major emissions sources associated with activities for the proposed BMDS in the Deciduous Forest Biome would include boilers, engines, hush houses, gas stations, fuel handling, chemicals, generators, storage tanks, miscellaneous equipment, and prescribed burning/firefighter training. Most sites where activities for the proposed BMDS may occur would be classified as a major emissions source. For example, at Wallops Flight Facility, an example of a coastal site in the biome, sources of air pollution include operation of the central boiler plant, rocket launches, disposal of rocket motors by open burning, aircraft emissions and auto emissions. (U.S. Department of the Navy, 1991)

Existing emissions sources in the coastal areas of the Deciduous Forest Biome are primarily the same as those in the inland areas. Industry and manufacturing sources historically are located in coastal urban areas because of access to marine transportation, so emissions levels from those sources would be greater on the coast than inland. Furthermore, because most of the existing sites in the Deciduous Forest Biome are on the coast, many of the activities for the proposed BMDS would occur in this biome.

The East Asian continental rim region is characterized by anthropogenic emissions that are already high in many localities and are increasing throughout the region more rapidly than in most other parts of the world. Within two decades, emissions from East Asia could account for roughly half of the sulfur and N_2 and a third of the carbon emitted from all anthropogenic sources worldwide. (IGAC, 2000) Air pollution in urban areas along the East Asian Coast (with a drastically expanding transportation sector) originates

predominately from traffic, power generation, home cooking, and biomass burning. (World Bank, 2003b) In addition, widespread transport of Asian-originated emissions is a growing concern. Aeolian dusts and gaseous and particulate pollutants from the Asian continent, including NO_x and polycyclic aromatic hydrocarbons, are transported eastward over the Pacific, especially in the spring, towards the western U.S.

H.3.2 Airspace

Controlled and Uncontrolled Airspace

The Deciduous Forest Biome in the U.S. contains all FAA classifications for airspace, as described in Section 3.1.2. Airspace at Santa Rosa Island on Eglin AFB is described as representative of airspace for this biome. Approximately 85 kilometers (53 miles) to the west and 107 kilometers (66 miles) to the east of the Santa Rosa Island launch site, is controlled airspace. This airspace is composed of Class A airspace from 5,486 meters (18,000 feet) above MSL up to and including FL 600, including the airspace overlying the waters within 22.2 kilometers (12 nautical miles) of the coast, and Class E airspace below 5,486.4 meters (18.000 feet) above MSL. Class C and D airspace surrounds Pensacola and Pensacola Regional airports to the west of the special use airspace. No Class B airspace, which usually surrounds the nation’s busiest airports, or Class G (uncontrolled) airspace is found in the vicinity. (U.S. Army Space and Strategic Defense Command, 1994a)

The airspace beneath R-2915C is Class G uncontrolled airspace. However, there is Special Air Traffic Rule Part 93 Airspace at Eglin AFB. Part 93 Airspace is established to cover certain special situations of air traffic where normal rules do not apply. The Part 93 Airspace underlies R-2915C and extends eastward underneath R-2919B. It requires pilots to obtain an Air Traffic Control clearance/advisory prior to entering or operating in the Eglin/Valparaiso terminal area. (U.S. Army Space and Strategic Defense Command, 1994a)

The deciduous forest parts of East Asia are located in international airspace and therefore, the procedures of the ICAO are followed. The Honolulu ARTCC would manage airspace in this region.

Special Use Airspace

The special use airspace for Santa Rosa Island on Eglin AFB consists of the following areas: R-2915C restricted area, which lies immediately above Sites A-15 and A-10 on Santa Rosa Island; the western portion of the overlying Eglin E MOA; the Santa Rosa CFA; and the W-l55A and W-151A warning areas offshore. The R-2915A restricted area is part of the special use airspace complex over Eglin AFB, which includes several

restricted areas, the Eglin E and Eglin F MOAs, and two Special Air Traffic Rule Corridors. (U.S. Army Space and Strategic Defense Command, 1994a)

W-151 is a large volume of airspace extending south and east of Eglin AFB to Cape San Blas and approximately 190 kilometers (118 miles) over the Gulf of Mexico. The large warning area is divided into smaller units for airspace management purposes. The W-151 Test Area is scheduled for more than 27,000 hours per year and is used by approximately 15,000 sorties per year. Training accounts for 80 percent of the total hours scheduled for W-151. Test activities account for most of the rest, with exercises taking less than one percent. W-470 is adjacent to and east of W-151. The W-470 Test Area is scheduled for more than 13,000 hours per year and is used by approximately 20,000 sorties per year. W-155 Test Area is scheduled primarily by the U.S. Navy for more than 3,300 hours per year. The Navy conducts surface to air and surface-to-surface missile testing using Eglin restricted airspace, W-151, and the Eglin Water Test Area several times a year. (U.S. Army Space and Strategic Defense Command, 1994a)

An east-west corridor underlies the R-2915C restricted area over and just south of Santa Rosa Island. The purpose of the Special Air Traffic Rule Corridors is to alert aircraft that they must contact the appropriate air traffic control function prior to flight entry or operation in these terminal areas to obtain routing and altitude clearance. The east-west corridor extends from the surface to 2,591 meters (8,500 feet) above MSL, commencing at the eastern boundary of R-29148, continuing between and below the northern and southern boundaries of R-29148 and R-2919B, and west below R-2915C. (U.S. Army Space and Strategic Defense Command, 1994a)

Unless otherwise authorized by the Eglin Radar Control Facility, aircraft cannot operate within the corridor without two-way radio communication with the Eglin Radar Control Facility or an appropriate FAA facility. The east-west corridor allows non-participating aircraft access to airports in the Eglin AFB-Fort Walton Beach area. Low-altitude/low speed private and commercial aircraft also use this corridor. (U.S. Army Space and Strategic Defense Command, 1994a)

Facilities would be required to request NOTMARS and NOTAMs prior to each test. Missile and target drone flight paths and intercepts may take place over the Gulf of Mexico within the confines of warning areas W-151 and W-470. Jacksonville ARTCC controls this airspace, which extends from sea level to an unlimited altitude and currently is in use only intermittently. W-151 and W-470 are not crossed by any low-altitude airways or any high-altitude jet routes, although Gulf Route 26 (low altitude) and J58-86 (high altitude) pass just to the south. (U.S. Army Space and Strategic Defense Command, 1994a)

Airports/Airfields

Civilian, military, and private airports exist in the Deciduous Forest Biome to serve different aircraft. Considerable civil and commercial flying activities take place in this biome. For example, approximately five civil airports located near Eglin AFB would be affected by closure of Eglin's Part 93 Airspace. General aviation aircraft may fly unrestricted in VFR conditions up to 5,486 meters (18,000 feet) above MSL. (U.S. Army Space and Strategic Defense Command, 1998a)

En Route Airways and Jet Routes

Numerous airways and jet routes that traverse international airspace are found in this biome. The airway and jet route segments located near Eglin AFB lie within airspace managed by Jacksonville, Miami, and Houston ARTCCs, and Houston Oceanic Control. ARTCCs exercise control of air traffic within sectors, usually dividing the airspace both vertically and horizontally. The vertical divisions, Low, High, and Ultra-High, are further divided into several horizontal sectors. Both ARTCCs and Oceanic Control activate and deactivate the various sectors as traffic loads warrant, and no set times are used. (U.S. Army Space and Strategic Defense Command, 1998a)

Jacksonville ARTCC manages traffic in Sector 30, which extends from the surface. It covers the area south of the Florida panhandle from the Florida Coast on the east to Mobile, Alabama, on the west and south to the boundary with Miami ARTCC. Miami ARTCC manages Sectors five, six, and eight south of Jacksonville's airspace past the southern tip of Florida and west to the 100-degree latitude, where it abuts Houston-managed airspace. Houston ARTCC manages traffic in Sector 24, which extends from the surface. It covers the area south of the New Orleans area, from Mobile, Alabama, on the east to Baton Rouge on the west, and south to the boundary with Houston Oceanic. Houston Oceanic manages Sector 29 south of Houston ARTCC to the northern edge of Merida (Mexico) Upper Control Area, from Miami Oceanic on the east to Monterrey (Mexico) Upper Control Area on the west. (U.S. Army Space and Strategic Defense Command, 1998a)

H.3.3 Biological Resources

Vegetation

On numerous sites where activities for the proposed BMDS may occur, native vegetation has been removed, and the land is landscaped and maintained by mowing and brush control measures. Isolated pockets of vegetation may remain on sites where activities for the proposed BMDS may occur, however, vegetation on off-site areas is widespread and may be undisturbed.

Although evergreens are found in this region, the Deciduous Forest Biome is characterized by an abundance of deciduous trees. In deciduous forests there are five different zones. The first zone is the tree stratum zone, which contains such trees as oak, beech, maple, chestnut hickory, elm, basswood, linden (*Tilia platyphylla*), walnut, and sweet gum (*Liquidambar styraciflua*) and has height ranges between 18 and 30 meters (60 and 100 feet). The small tree and sapling zone, the second zone, has young and short trees. The third zone, the shrub zone, includes such shrubs as rhododendrons (*R. Fragrantissimum*), azaleas, mountain laurel, and huckleberries. The Herb zone is the fourth zone, which contains short plants such as herbal plants. The final zone is the Ground zone, which contains lichen, club mosses, and true mosses.

At Redstone Arsenal, Alabama, an existing site in this biome, vegetation consists largely of forests, shrublands, cultivated land and pastures, and mowed, grassy areas. Approximately 20 percent of the installation is covered by wetlands. The Wheeler National Wildlife Refuge is located along the southern boundary of Redstone Arsenal; 1,620 hectares (4,000 acres) of the refuge are located within Redstone Arsenal.

The vegetation along the U.S. Atlantic coast is widely varied. The Everglades region is dominated by two principal natural communities adapted to moist conditions, an extensive treeless savanna (the Everglades) on the eastern side of the area and forested woodlands (the Big Cypress Swamp) on the western side. The Everglades region consists of a shallow, broad (95 kilometers [60 miles]) river with freshwater flowing southward from Lake Okeechobee to the Gulf of Mexico. Vegetation here varies by duration of inundation and amount of salt content and includes grasses in permanently submerged freshwater habitats, trees in dry to intermittently flooded freshwater habitats, and shrubs to small trees in saltwater estuary habitats. Coastal areas influenced by saltwater tidal zones are occupied by successive zones of vegetation from freshwater to saltwater environments and include button mangroves, black mangroves, and red mangroves.

For example, on Cape San Blas, an existing site located in Florida, the vegetation is typical of Atlantic or Gulf barrier island vegetation associations. Salt tolerance is an important factor in the tidal communities along the beaches. Fresh or brackish water communities are found behind the primary dune system and are scrubby or forested marshes and swamps. Cape San Blas also has upland habitat, including flatwoods, shrubs, xeric and old scrub dunes, and a variety of disturbed areas in various stages of recovery. Several stands of large pines occur at Cape San Blas.

In the Outer Coastal Plain, gum and cypress trees dominate the extensive coastal marshes and interior swamps. The American Chaffseed (*Schwalbea americana*) is an example of a threatened or endangered species in the Outer Coastal Plain.

Further north in the deciduous forest, predominant vegetation includes northern hardwood-hemlock-white pine, central hardwoods, transition hardwoods, coastal pitch pine, maritime oak and maritime red cedar. Albany sand plains support pitch pine-scrub oak communities. There are also cedar bogs with transition pine forests and deciduous swamps, and pine plains and grassy savannas, especially in the pine barrens area.

Predominant vegetation types in the northeast include montane red spruce-balsam fir, lowland spruce-fir, northern hardwood-conifer, lowland red spruce-balsam fir, coastal spruce-fir, coastal raised peatlands, and coastal plateau peat lands. The central coast of Maine is described as a transitional zone. From west to east the forest transition ranges from northern Appalachian oak, pine, and mixed hardwoods typical of the southern New England coastal plain to northern coastal spruce-fir and spruce-fir-northern hardwood communities. From south to north, coastal communities grade to more montane spruce-fir and northern hardwood communities. Coastal pitch pine communities are represented on sand dunes and outcrops in the coastal zone.

Wildlife

The Deciduous Forest Biome provides habitat for a wide variety of animals. The black bear (*Ursus americanus*) and the endangered Florida panther are found in small numbers in isolated areas, and the whitetail deer is one of the only large indigenous mammals. Common small mammals include raccoons (*Procyon lotor*), opossums, flying squirrels, rabbits, red fox and numerous species of ground-dwelling rodents. Bobwhite and wild turkey are the principal game birds. Migratory non-game bird species are numerous, as are migratory waterfowl. Ducks, geese, rails, herons, shore birds, beaver, mink, and muskrats are found in inland ponds, marshes, and swamps. Winter birds are diverse and numerous. The endangered red-cockaded woodpecker (*Picoides borealis*), bald eagle, and the Atlantic piping plover (*Charadrius melodus*) inhabit the lower coastal plains and flatlands of the middle portion of this biome. Further north, threatened and endangered species include the gray wolf, mountain lion, lynx, peregrine falcon, and bald eagle.

Fort Devens, Massachusetts, is an existing inland site in this biome. Undeveloped lands of this installation are known to support migratory birds including waterfowl, wading birds, raptors, shorebirds, and passerrines (perching birds). Other species found on site include resident mammals, reptiles and amphibians, and invertebrates. The installation lands support breeding areas for at least 12 state-listed animal species and provide migration, feeding, and resting habitat for two federally listed endangered species.

The neighboring Oxbow National Wildlife Refuge is a migratory bird refuge on the Atlantic Flyway. Swamp and floodplains surround the oxbows of the Nashua River. On the upland edge a few pine-covered knolls, marshes, swamps and open water areas exist. The Oxbow refuge is also a good birding area where pheasant, woodcock, grouse, snipe, bittern, herons, sandpipers, passerines and woodland birds are likely to be found. Ducks

and geese can be present, especially during migration periods. It is assumed that birds found on the refuge also will fly over or utilize the Fort Devens area. Raptors that are expected to use the base area during the breeding season include the American kestrel (*Falco sparverius*), red-tailed hawk (*Buteo jamaicensis*), screech (*Otus asio*), barred (*Strix varia*) and great horned owls (*Bubo virginianus*), plus the forest dwelling sharp-shinned (*Accipiter striatus*), coopers (*Accipiter cooperii*) and goshawks (*Accipiter gentiles*), and the red-shouldered (*Buteo lineatus*) and broad-winged (*Buteo platypterus*) hawks. Many additional species have been identified during migration. (U.S. Army Space and Strategic Defense Command, 1994b)

Oxbow National Wildlife Refuge and Fort Devens are also home to several mammalian species. Those likely to be observed are woodchucks (*Marmota monax*), snowshoe hares (*Lepus Americanus*), red (*Tamiasciurus hudsonicus*) and gray squirrels and cottontail rabbits. Those less likely to be observed are raccoons, skunks, opossum, river otters (*Lutra Canadensis*), red foxes, muskrats, and white-tailed deer (*Odocoileus virginianus*). (U.S. Army Space and Strategic Defense Command, 1994b)

Wetlands and open water habitats are known to support populations of mink (*Mustela vison*), river otter, muskrat, and beaver. There are eighteen species of reptiles and thirteen species of amphibians known to utilize the upland and wetland habitats at Fort Devens. The reptile species include various turtles and snakes, and amphibian species include mole salamanders, newts, lungless salamanders, toads, tree frogs, and true frogs. (U.S. Army Space and Strategic Defense Command, 1994b)

The Federally listed species near Fort Devens are the peregrine falcon and the bald eagle, and the candidate species is the Northern Goshawk. No other federally listed threatened or endangered species occur in the area. Exhibit H-4 shows examples of threatened and endangered wildlife species in the Deciduous Forest Biome.

Exhibit H-4. Examples of Threatened and Endangered Wildlife Species in the Deciduous Forest Biome

Common Name (*Scientific Name*)	Threatened (T) or Endangered (E)
Indiana bat *(Myotis sodalist)*	E
Eastern cougar *(Puma (Felis) concolor couguar)*	E
Bat, Virginia big-eared *(Corynorhinus (Plecotus) townsendii virginianus)*	E
Heather, mountain golden *(Hudsonia montana)*	T

Source: USFWS, 2003

Along the coast, the Everglades region contains both freshwater and saltwater habitats, and both habitats contain a wide variety of species. The freshwater habitats are occupied by woodstork (*Mycteria Americana*), bluegill (*Lepomis macrochirus*), crayfish, Florida gar (*Lepisosteus platyrhincus*), largemouth bass (*Micropterus salmoides*), purple gallinule (*Porphyrula martinica*), alligator, ibis (*Plegadis falcinellus*), zebra butterfly (*Heliconius charitonius*), Everglades kite (*Rostrhamus sociabilis*), and apple snail (*Pomacea bridgesii*). Characteristic fauna of the hammocks are various species of tree snails, barred owl, white-tailed deer, and Florida panther (*Puma concolor coryi*). In saltwater habitats, typical fauna include great white heron (*Ardea herodias occidentalis*), American crocodile (*Crocodylus acutus*), loggerhead turtle (*Caretta caretta*), West Indian manatee (*Trichechus senegalensis*), pink shrimp, mangrove snapper (*Lutjanus griseus*), blue crab (*Calinectes sapidus*), coon oyster (*Crassostrea m, lntertldal*), brown pelican (*Pelecanus occidentalis*), osprey (*Pandion haliaetus*), roseate spoonbill (*Ajaia ajaja*), and southern bald eagle (*Haliaeetus leucocephalus*). Exhibit H-5 contains examples of the threatened and endangered species of the Everglades.

Exhibit H-5. Examples of Threatened and Endangered Species of the Everglades

Type of Species	Common Name (*Scientific Name*)	Threatened (T) or Endangered (E)
Reptiles and Amphibians	Atlantic Ridley Turtle (*Lepidochelys kempi*)	E
	American Crocodile (*Crocodylus acutus*)	E
Birds	Southern Bald Eagle (*Haliaeetus leucocephalus leucocephalus*)	T
Mammals	Florida Panther (*Puma concolor coryi*)	E
	West Indian Manatee (*Trichechus manatus*)	E
Insects	Schaus Swallowtail Butterfly (*Heraclides aristodemus*)	E

Source: USFWS, 2003

Gulf of Mexico estuaries provide critical feeding, spawning, and nursery habitats for a rich assemblage of fish, wildlife, and plant species. Hundreds of species of birds, recreational and commercial fish and shellfish species, native cypress and mangroves, and threatened and endangered species such as sea turtles, Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), beach mice, and manatees can be found in Gulf estuary habitats.

Along the northeastern coast, the northern spring salamander (*Gyrinophilus porphyriticus*), four-toed salamander (*Hemidactylium scutatum*), grey tree frog (*Hyla versicolor*), mink frog (*Rana septentrionalis*), American toad (*Bufo americanus*), eastern

box turtle (*Terrapene carolina Carolina*) northern brown snake (*Storeria dekayi*)., and eastern milk snake (*Lampropeltis triangulum*) characterize rich reptile and amphibian populations. Peregrine falcons are returning to coastal areas to nest. The storm petrel (*Hydrobates pelagicus*), razorbill (*Alca tord*), roseate tern (*Sterna dougallii*), laughing gull (*Larus atricilla*), Atlantic puffin (*Fraterculus arctica*), black guillemot (*Cepphus grylle*), and sharp-tailed sparrow (*Ammospiza caudacuta*) occur in a variety of coastal habitats. Historically, Atlantic salmon was found in the major rivers (Penobscot and Kennebec) of this area. Restoration of Atlantic salmon to the Penobscot is underway. Numerous whales, dolphins, and seals seasonally migrate through the Gulf of Maine, as do several marine turtle species such as the leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), and Atlantic Ridley turtle (*Lepidochelys kempi*). No Federally listed threatened and endangered species are unique to this area.

The canopy in the East Asian tropical and subtropical moist broadleaf forests is home to many of the forest's animals, including apes and monkeys. Below the canopy, the lower understory contains snakes and big cats. The forest floor, relatively clear of undergrowth due to the thick canopy above, is home to animals such as gorillas and deer. Wildlife specific to this biome in East Asia include the Calamian deer (*Axis calamianesis*), Chinese pangolin (*Manis pentadactyla*), Sunda tree squirrel (*Sundasciurus juvencus*), and gray imperial-pigeon (*Ducula pickeringii*). Characteristic wildlife of the temperate broadleaf and mixed forest are either mast-eaters (nut and acorn feeders) or omnivores. Mammals show adaptations to an arboreal life and a few hibernate during the winter months. Wildlife specific to this biome in Asia include the Japanese otter (*Lutra Iatra whiteleyi*), Japanese serow (*Capricornis crispus*), Shika deer (*Cervis nippon*), Blakeston's fish owl and Tokyo Salamander (*Hynobius tokyoensis*). The Okinawa Woodpecker is an example of a threatened species that occurs in the Southeast Asia portion of the Deciduous Forest Biome.

Environmentally Sensitive Habitat

The Florida Keys have been designated a National Marine Sanctuary, Outstanding Florida Waters, and an Area of Critical State Concern. In addition, the Nature Conservancy has designated the Keys one of the ten most significant ecological communities in the world. (U.S. Army Space and Strategic Defense Command, 1998a)

For example, Cape San Blas, Florida encompasses habitat that is of unique and critical importance, perhaps the most conspicuous of which is the coastal beach and primary dune system. A variety of micro-habitats exist within the three miles of beach front at Cape San Blas, including overwash sites, mud flats, and sandbars. Cape San Blas is within a migratory bird route and is heavily used by a wide variety of migratory shorebirds throughout the year. Cape San Blas also is a known shorebird wintering and nesting area. Of special concern are sea turtles, which nest along the Cape San Blas shoreline, particularly the Atlantic loggerhead. Cape San Blas has the highest sea turtle

nesting density in northwest Florida with approximately ten nests per kilometer (15 nests per mile). (U.S. Army Space and Strategic Defense Command, 1998a)

H.3.4 Geology and Soils

Geology

The geology of the Deciduous Forest inland is varied. The Appalachian Mountains run the length of this region. They are low mountains of crystalline rocks with valleys underlain by folded strong and weak strata. Some dissected plateaus with mountainous topography are also present. The relief is high (up to 900 meters [3,000 feet]). Elevations range from 90 to 1,800 meters (300 to 6,000 feet) and are higher to the south, reaching 2,037 meters (6,684 feet) at Mount Mitchell, North Carolina. West of the Appalachian Mountains are the Appalachian Plateaus. The sedimentary formations there are nearly horizontal, a typical plateau structure, but they are so elevated and dissected that the landforms are mostly hilly and mountainous. Altitudes range from about 300 meters (1,000 feet) along their western edge to somewhat more than 900 meters (3,000 feet) on the eastern edge. East of the mountains is the Piedmont Plateau and coastal plain, where altitudes range from sea level to about 300 meters (1,000 feet).
Most of New England is comprised of glacial features such as small to large delta plains, lake basins, isolated mounds and extended ridges of unstratified rocks. The area gradually descends in a series of broad, hilly plateaus to the coastal zone. Elevation ranges from sea level to 450 meters (1,500 feet), with some high hills in lower New England (monadnocks) at 600 meters (2,000 feet). Most of the Upper Atlantic Coastal Plain has elevations of less than 50 meters (150 feet). In the northernmost part of Lower New England, coastal lowlands are covered by glacial marine sediments (mostly clay). Inland, the bedrock is covered by a thin layer of glacial sediments deposited by rivers and in lakes. In the Upper Atlantic Coastal Plain, a series of terraces is composed of progressively younger sediment layers that range from poorly defined to unconsolidated and include interbedded mud, silt, sand, and gravel.

The Coastal Plain is predominantly flat and is covered with terrestrial sediments. Elevation ranges from 0 to 25 meters (0 to 80 feet) in the Middle Atlantic Coastal Plain, Atlantic Coastal Flatlands, and along the West Florida Coastal Lowlands, and from 0 to 50 meters (0 to 160 feet) along the Louisiana Coastal Prairies and Marshes. Elevation ranges from 25 to 200 meters (80 to 660 feet) along the Lower Coastal Plains and Flatwoods and in the Western Gulf Coastal Plains and Flatlands. The majority of the mid Atlantic coastal area is characterized by low ridges surrounded by poorly drained and relatively flat terrain. Lakeshore and river erosion, transport, and deposition are the primary processes shaping the landscape. Elevation ranges from 25 to 300 meters (80 to 1,000 feet). Most of this province has low relief, but rolling hills occur in many places. Lakes, poorly drained depressions, morainic hills (those created by an accumulation of earth and stones carried and deposited by a glacier), drumlins (oval hills made by glacial

drift), eskers (long narrow ridges or mounds of sand, gravel, and boulders deposited by a stream flowing on, within, or beneath a stagnant glacier), outwash plains, and other glacial features are typical of the area, which was entirely covered by glaciers during parts of the Pleistocene era. Elevations range from sea level to 730 meters (2,400 feet). The coastal lowlands are covered by Pleistocene marine sediments (mostly clay). Stratified drift overlay the rest of the bedrock.

The Everglades, in the coastal area of this biome, are predominantly a flat plain. The sediments covering the plain are of marine origin. Elevation ranges from sea level to 25 meters (85 feet). Poorly defined broad streams, canals, and ditches drain into the ocean. Much of south Florida is underlain by a fossiliferous limestone, a rock composed primarily of calcium carbonate. The calcium carbonate is subject to dissolution when exposed to acidic water, such as acid rain.

Soils

Deciduous trees shed their leaves each fall, and as the leaves decompose, the soil absorbs the nutrients contained in the leaves. For this reason, the soils of this ecological system tend to be fertile due to high amounts of decaying organic matter. There are two types of soil found in deciduous forests in the U.S. Fertile soils with high organic content occupy roughly 14 percent of the U.S. land area. These soils are rich in nutrients and have well-developed layers of clay. The second type, the "red clay" soil occupies roughly nine percent of the U.S. and is found mainly in the southeast. These "red clay" soils are found in humid temperate and tropical areas of the world, typically on older, stable landscapes. While the clay layer is well developed, many of the nutrients have been washed or leached out of the soil over time. Because of the favorable climate regime, these soils can support productive forests, but are poorly suited for continuous agriculture without the use of fertilizer and lime.

For example, Fort Belvoir, Virginia has uplands that are underlain by sands, silts, and clays of riverine origin. Uplands underlain by sands and silts tend to be more stable than those underlain by clays. Uplands that are underlain by clayey soils form undulating and rolling hills, and the dominant geomorphic process in these areas is mass wasting that includes downhill creep, landslides, slumping, and rock falls. Lowlands and valley bottoms are typically underlain with alluvium. The dominant geomorphic process is active riverine erosion and deposition during overbank flooding. Surface drainage is commonly poor due to the shallow water table. Drainage usually occurs as surface runoff, with runoff greatest on the steeper slopes and increasing with construction activity and the removal of vegetation, which greatly increases the rate of erosion and the probability of creep and slumping.

In coastal areas of this biome, soils are predominantly deep and adequately drained. However, those soils found in the Western Florida Coastal Lowlands and part of the

Louisiana Coastal Prairies and Marshes are poorly drained. Soils in the Everglades are composed mainly of organic materials and have varying degrees of stratification. Most soils inland from the Florida coasts are poorly drained, shallow, and moderately textured. Some coastal soils are deep sands that are well drained or excessively drained. These soils are topographically situated in low-lying areas and are subject to tidal flooding.

Geological Hazards

Because limited seismic activity occurs along the Atlantic continental shelf, the risk of an earthquake in the Deciduous Forest Biome is low. For example, there are no known areas of volcanic activity within Alabama, where the existing Redstone Arsenal is located. According to the Uniform Building Code, this installation is located in seismic zone 1. Within this seismic zone there is a low probability of earthquakes. No unique geologic landforms have been identified in the area.

Volcanic activity generally is not observed along the U.S. Atlantic and Gulf Coasts, however, cracks present in the Eastern Seaboard have the potential to cause the seabed to crumble and create a tsunami that would push huge masses of seawater toward the coast.

Landslides are a significant geologic hazard throughout the Deciduous Forest Biome.

The U.S. Atlantic and Gulf Coasts are susceptible to coastal land loss. The physical factors that have the greatest influence on coastal land loss are reductions in sediment supply, relative sea level rise, and frequent storms, including hurricanes, whereas the most important human activities are sediment excavation, river modification, and coastal construction. As a result of these agents and activities, coastal land loss is manifested most commonly as beach or bluff erosion and coastal submergence.

H.3.5 Hazardous Materials and Hazardous Waste

Hazardous Materials

At the Stennis Space Center in Mississippi, an existing site in the Deciduous Forest Biome, numerous types of hazardous materials are used to support its various missions, research, operations, and general maintenance. These materials include common building paints, industrial solvents, and certain chemicals used in the scientific and photographic labs. Propellant and oxidizer are used to test rocket engine components. Hazardous materials also are used by on-station contractors to support station construction and operations. Hazardous materials such as solvents and paints, chlorine, sulfuric acid, oils, sodium hydroxide, and sulfide solutions are used in maintenance activities. (BMDO, 2001)

Under CERCLA, the resident agencies at the Stennis Space Center, NASA, and contractors are responsible for reporting releases of reportable quantities to the National Response Center within 24 hours. The Stennis Space Center implements this program through NASA Management Instruction 1040.1C, which provides a comprehensive emergency plan. Routine and accidental releases, as well as quantities of listed chemicals stored on site, are reported annually in accordance with the Emergency Planning and Community Right To Know Act. The Stennis Space Center Fire Department is trained to handle hazardous materials. (BMDO, 2001)

Federal Oil Pollution Prevention regulations require the preparation of an SPCC Plan for aboveground petroleum storage tanks with a capacity greater than 2,500 liters (660 gallons) or 5,000 liters (1,320 gallons) in aggregate. The Stennis Space Center has a limited number of tanks to which this requirement applies. The Stennis Space Center maintains an SPCC Plan as part of the contingency plan (SPG 4l30.3C). (BMDO, 2001)

Hazardous materials commonly utilized at Cape Cod Air Force Station, Massachusetts, an existing site in the coastal section of this biome, include adhesives; batteries; biocides; corrosives; ethylene glycol (antifreeze); diesel fuel; gasoline; paint; petroleum, oil, and lubricants; solvents; biocides; and household products. (U.S. Department of the Air Force, 2002) In addition, the main mission computers generate a large amount of heat and are mechanically cooled using approximately 45 kilograms (100 pounds) of the hydrochlorofluorocarbon refrigerant R-401a. R-401a is an ozone-depleting substance, but it is not listed as a Class I or Class II ozone-depleting substance due to its low ozone-depleting potential. The installation does not vent R-401a to the atmosphere; it is reclaimed. The Tech Facility Chiller utilizes approximately 1,900 kilograms (4,200 pounds) of R-134a, which is not an ozone-depleting substance.

Hazardous Waste

Hazardous materials and hazardous waste are stored and managed in accordance with applicable laws and regulations. At Redstone Arsenal, Alabama, hazardous waste is stored prior to disposal in igloos in restricted areas. Each igloo is designated for one type of waste and is inspected on a regular basis. At some installations, it is the responsibility of each contractor to manage and dispose of all hazardous waste generated from its operations in accordance with all local, state, and Federal regulations. (U.S. Department of the Air Force, 2000) For example, at the Stennis Space Center, Mississippi, all individuals or organizations are responsible for administering the applicable regulations and plans regarding hazardous waste and for complying with applicable regulations regarding the temporary accumulation of waste at the process site. Individual contractors and organizations maintain hazardous waste satellite accumulation points and 90-day hazardous waste accumulation areas in accordance with 40 CFR 262.34. All hazardous wastes placed in the accumulation areas must be shipped off-site for treatment, storage, and disposal within 90 days of the start of accumulation.

At other installations, DoD contracts out waste management responsibilities to local private companies. For example, Cape Cod Air Force Station is considered a small quantity generator of hazardous waste. The installation generates less than 1,000 kilograms of hazardous waste per month and can accumulate up to 6,000 kilograms (13,000 pounds) of hazardous waste on site at any one time. As a small quantity generator, Cape Cod Air Force Station can store hazardous waste on site for up to 180 days (only if the amount stored is less than 6,000 kilograms (13,000 pounds)) before shipping the waste to an off-site disposal location. The Defense Reutilization and Marketing Office (DRMO) in Groton, Connecticut, or Portsmouth, New Hampshire, acts as the principal agent for the procurement of an environmental services disposal company to transport and dispose of hazardous waste generated at Cape Cod Air Force Station. (U.S. Department of the Air Force, 2002)

Underground storage tanks (USTs) are subject to Federal regulations within RCRA, 42 United States Code (U.S.C.) 6991, and EPA regulations, Title 40 CFR 265. Aboveground storage tanks are subject to regulation under the Clean Water Act (33 U.S.C. 1251-1578) and oil pollution provisions (40 CFR 112). For example, the Mississippi Department of Environmental Quality has adopted the Federal UST program and is the administering agency for USTs at the Stennis Space Center, Mississippi. Currently, Stennis Space Center contains three USTs and twenty-four ASTs that are subject to Federal regulations. (BMDO, 2001)

H.3.6 Health and Safety

Health and Safety attributes of the Deciduous Forest Biome are similar to those discussed in Section H.1.6.

H.3.7 Noise

The Eastern Range is a representative example of noise levels for sites where activities for the proposed BMDS may occur in the Deciduous Forest Biome. Ambient noise levels based on daytime monitoring, range from 60 dBA to 80 dBA. (DOT, 2001) Noise sources associated with the proposed BMDS are similar to those described in Section H.1.7.

H.3.8 Transportation

Coastal environments sustain widespread infrastructure, including marine ports and docks that are supported by traffic circulation systems such as highways and byways, unpaved roads, non-maintained roads, trails, railroad lines, municipal, private, and military airports and any other system involved in mass transportation.

Ground Transportation

For example, at Cape Canaveral Air Force Station, Florida, on-site roadways provide access to launch complexes, support facilities, and industrial areas. During peak hours, traffic flow remains steady, and significant delays seldom occur. Several off-site roads and major highways provide access to the installation. Railways transport both cargo and passengers in the region. (U.S. Army Space and Missile Defense Command, 1999a)

Air Transportation

There are numerous commercial, private, and military airports within the Deciduous Forest Biome. They vary in size from major international airports such as Hartsfield-Jackson Atlanta International Airport in Georgia that supports 80 million passengers each year to small, rural airstrips that support single engine planes.

Marine Transportation

The top ports in U.S. foreign trade are deep draft (with drafts of at least 12 meters [40 feet]). Twenty-five U.S. ports, located within the Deciduous Forest Biome, received 73 percent of total vessel calls, including Portland, Maine; New York, New York; Baltimore, Maryland; Hampton Roads, Virginia; Charleston, South Carolina; Savannah, Georgia; Jacksonville, Florida; Miami, Florida; Port Everglades, Florida; Mobile, Alabama; Lake Charles, Louisiana; LOOP Terminal, Louisiana; Beaumont, Texas; Corpus Christi, Texas; Freeport, Texas; and Texas City, Texas. Of vessels over 1,000 gross tons, tankers and containerships called at U.S. ports more often in 2000 than did other types of vessels. (DOT Bureau of Transportation Statistics (BTS), 2001)

H.3.9 Water Resources

Surface Water and Ground Water Resources

Ground water provides about 40 percent of the U.S. public water supply. Freshwater aquifers along the Atlantic coastal zone are among the most productive in the U.S., supplying drinking water to an estimated 30 million people from Maine to Florida. (USGS, 2000) More than 40 million people, including most of the rural population, supply their own drinking water from domestic wells. Ground water is also the source of much of the water used for irrigation. It is the principal reserve of fresh water and represents much of the potential future water supply. Ground water is a major contributor to flow in many streams and rivers and has a strong influence on river and wetland habitats for plants and animals.

In the Northern U.S. coastal areas, nearly all rural, domestic, and small-community water systems obtain water from ground water wells. Where water demand is great,

sophisticated reservoir, pipeline, and purification systems are needed to meet demands. In the Mid-Atlantic, rivers are important sources of water supply for many cities, but populations living on the Coastal Plain depend on ground water for supply. For example, at Cape San Blas, Florida, the Floridian aquifer is the primary potable water source, although the surficial aquifer may be used as a potable water source in rural areas.

Ground water resources along the Atlantic Coast are vulnerable to saltwater intrusion and nutrient contamination. Saltwater intrusion, the movement of saline water into freshwater aquifers, is most often caused by ground water pumping near the coast. Nutrient contamination results from many human activities and has caused widespread increases of nitrate in shallow ground water. (USGS, 2000)

Sole Source Aquifer designations under the Safe Drinking Water Act protect drinking water supplies in areas with few or no alternative sources to the ground water resource, or where, if contamination occurred, using an alternative source would be extremely expensive. The designation protects an area's ground water resource by requiring EPA review of any proposed projects within the designated area that are receiving Federal financial assistance. Many sole-source aquifers have been designated in coastal areas, especially on near shore islands. For example, there are 15 designated Sole Source Aquifers in New England, most of which are in coastal areas. (EPA, 2003a)

The Coastal Plain of the Atlantic Coast has a moderate density of small to medium size perennial streams and a low density of associated rivers, most with moderate volume of water flowing at very low velocity. In the Mid-Atlantic Coastal Flatlands and Lowlands and Louisiana Prairies and Marshes, the water table is high in many areas, resulting in poor natural drainage and abundance of wetlands. In the Lower Coastal Plains, few natural lakes occur, except in central Florida where they are abundant. Large, freshwater springs are common in central Florida, especially in areas of limestone rock formations.

In the Upper Atlantic Coastal Plain streams flow relatively slowly to the Atlantic Ocean or the Delaware Bay. Natural lakes are rare to non-existent. Small water impoundments are common along the upper reaches of streams. Bogs, swamps, and salt marshes exist along the Atlantic Coast. Bogs tend to be very acidic. Rates of stream flow near the Delaware Bay and the coast fluctuate daily in response to tides. Tests show that salt content is sufficiently low that tidewater from streams may be used for irrigation without adverse effects on soils and vegetation. Currently, there is ample water for farm, urban, and industrial uses. However, urban development increasingly affects the hydrology of the area, including infiltration, underground water storage, and runoff.

The source of most surface water in the Everglades, other than precipitation, is Lake Okeechobee, about 1,940 square kilometers (750 square miles) in area, immediately north of this area. Most waterways are canals that were built to carry a moderate to high volume of water at very low velocity. The water table is high in many areas, resulting in

poor natural drainage and abundance of wetlands. A poorly defined drainage pattern has developed on this landscape, which is relatively young and weakly dissected.

Water Quality

The quality of the ocean along the east coast of the U.S. is highly impacted by human activity. A great percentage of our population lives within 50 miles of the coast and much of the land along the coast has been developed. Water testing shows that the ocean of the Mid-Atlantic is highly affected by the flow into the ocean from the Hudson River, the Delaware River, and the Chesapeake Bay. Water that falls on land can make its way to streams and rivers that empty into the ocean, carrying pollutants, such as fertilizers and pesticides from farms and homes. Pollution of coastal waters also comes from rainfall that can carry particulates and other pollutants; sewage treatment plants; combined sewer overflows; and storm drains that discharge liquid waste directly into the ocean through pipelines, dumping of materials dredged from the bottoms of rivers and harbors, and waste from fish processing plants, legal and illegal dumping of wastes from ships and ground water from coastal areas.

Along the east coast, some indicators of water quality show improvement, while others indicate worsening conditions. Overall, the long-term trend is for increasing loads of contaminants in the ocean caused by an ever-increasing population impacting the coastal area. (EPA, 2003e)

The majority of estuaries assessed in the Gulf of Mexico were in good ecological condition, meaning that neither environmental stressors (nutrients, contaminants, etc.) nor aquatic life communities showed any signs of degradation. However, some estuaries showed indications of poor aquatic life conditions, and some were impaired for human uses.

These estuaries support submerged aquatic vegetation communities that stabilize shorelines from erosion, reduce non-point source loadings, improve water clarity, and provide habitat. Water clarity in Gulf Coast estuaries is fair. Water clarity was estimated by light penetration through the water column. For approximately 22 percent of the waters in Gulf of Mexico estuaries, less than ten percent of surface light penetrated to a depth of one meter (three feet). Dissolved oxygen conditions in Gulf Coast estuaries are generally good, except in a few highly eutrophic, or nutrient rich regions. Estimates for Gulf of Mexico estuaries show that about four percent of the bottom waters in the Gulf estuaries have hypoxic conditions characterized by low dissolved oxygen (less than 2 parts per million) on a continuing basis in late summer. These areas are largely associated with Chandeleur and Breton Sounds in Louisiana, some shoreline regions of Lake Pontchartrain, northern Florida Bay, and small estuaries associated with Galveston Bay, Mobile Bay, Mississippi Sound, and the Florida panhandle. While hypoxia resulting from human activities is a relatively local occurrence in Gulf of Mexico

estuaries, accounting for less than five percent of the estuarine bottom waters, the occurrence of hypoxia in the Gulf's shelf waters is much more significant. The Gulf of Mexico hypoxic zone is the largest zone of anthropogenic, or human-caused, coastal hypoxia in the Western Hemisphere. (NOAA, 2000) Since 1993, midsummer bottom water hypoxia in the northern Gulf of Mexico has been larger than 10,000 square kilometers (3,861 square miles), and in 1999, it reached 20,000 square kilometers (7,722 square miles). (NOAA, 2000)

Over half of the N_2 load comes from non-point sources north of the confluence of the Ohio and Mississippi Rivers, with much of the loading coming from the drainage of agricultural lands. (NOAA, 2000) Gulf of Mexico ecosystems and fisheries are affected by the widespread hypoxia. Mobile organisms leave the hypoxic zone for more oxygen-rich waters, and those that cannot leave die as a result of hypoxia.

The condition of Gulf Coast estuaries as measured by eutrophic (high nutrient) conditions is poor. Expression of eutrophic condition was high in 38 percent of the area in Gulf estuaries. The symptoms of eutrophic condition are expected to increase in over half of Gulf of Mexico estuaries by 2020. High expressions of chlorophyll were determined for about 30 percent of the estuarine area of the Gulf of Mexico. The areas with high chlorophyll were largely in Louisiana, Laguna Madre, Texas, Tampa Bay, Florida, and Charlotte Harbor, Florida. (EPA, 2003e)

The coastal wetlands indicator for the Gulf of Mexico receives a score of poor. Wetland losses along the Gulf of Mexico from the 1780s to 1980s are among the highest in the nation. Losses over the 200-year time span were 50 percent throughout the Gulf and ranged from 46 percent declines in Florida and Louisiana (although the absolute losses in these states were the highest) to a 59 percent decline in Mississippi. During the 1970s to 1980s, the Gulf lost five percent of its wetlands, with the largest declines seen in Texas. Not all of the wetland losses in the Gulf of Mexico are due to coastal development. Sea-level rise, coastal subsidence, and interference with normal erosion and depositional processes also contribute to wetland loss.

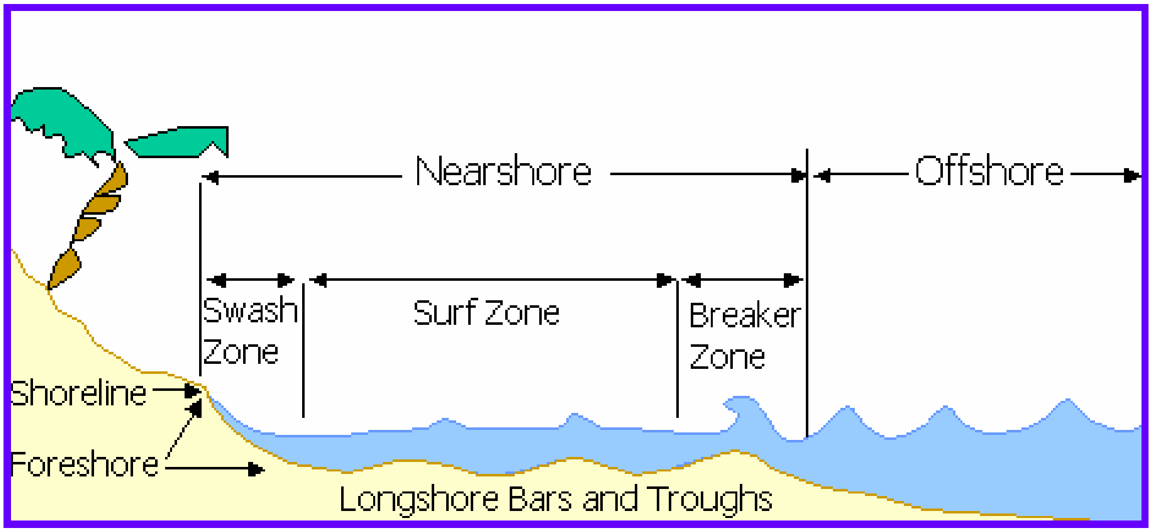
H.4 Chaparral Biome

The Chaparral Biome includes regions corresponding to those shown in Exhibit 3-14, but focuses on a portion of the California Coast and the coastal region of the Mediterranean from the Alps to the Sahara Desert and from the Atlantic Ocean to the Caspian Sea. Representative sites where activities for the proposed BMDS may occur are part of the Western Range, including Vandenberg AFB and the Point Mugu Sea Range.

Coastal areas consist of land areas that are affected by proximity to the sea, and sea areas that are affected by proximity to the land. As noted above, the coastal area consists of the Exclusive Economic Zone, which is 322 kilometers (200 miles) offshore and incorporates

the 19.3-kilometer (12-mile) designation often used by the Navy to define coastal areas. The coastal zone also extends one kilometer (.6 mile) inland of the coastal shoreline, tidal wetlands, coastal wetlands, and coastal estuaries. Sea-based activities may occur in near shore areas of the Chaparral Biome. The near shore is an indefinite zone extending seaward from the shoreline beyond the breaker zone (see Figure H-6). This typically includes water depths less than 20 meters (65 feet). (Discover the Outdoors, 2002)

Exhibit H-6. Near Shore Waters



Not to scale
Source: Texas A&M University, Division of Nearshore Research, 2003

H.4.1 Air Quality

Climate

Chaparral Biomes, also known as Mediterranean Biomes, occur along the California coast, Europe, Africa, Asia Minor, North America, and South America. Chaparrals exist between 30 and 40 degrees north and south latitude on the west coasts of continents. The climatic conditions that produce this biome include shore areas with nearby cold ocean currents. The California Chaparral Biome extends from northeastern Baja California, Mexico, northward along the Pacific into southern California in the U.S. The biome is bounded in the east by the Colorado-Sonora Desert and continues south as far as Punta Baja, Mexico and includes the Channel Islands (U.S.) and Cedros and Guadalupe Islands (Mexico). The Mediterranean Chaparral biome is localized in the coastal areas surrounding the Mediterranean Sea including parts of Europe, North Africa, and Asia Minor. (National Geographic, 2003a)

Chaparral climate is characterized by rugged coastal mountain ranges parallel to the coastline, which influence and modify climatic patterns, forming rain shadows and microclimates. (Atmosphere, Climate and Environment Programme, 2003) The

Chaparral climate consists of hot summer drought and winter rain in the mid-latitudes, north of the subtropical climate zone. The climate in this area is unique with the wet season occurring in winter and annual rainfall of only 38 to 102 centimeters (15 to 40 inches). Cold ocean currents and fog affect temperatures, which limit the growing season. The high-pressure belts of the subtropics drift northwards in the Northern Hemisphere from May to August and they coincide with substantially higher temperatures and little rainfall. During the winter, weather becomes dominated by the rain-bearing low-pressure depressions. While usually mild, such areas can experience cold snaps when exposed to the icy winds of the large continental interiors, where temperatures can drop to -40°C (-40^{o}F) in the extreme continental climates. (Atmosphere, Climate and Environment Programme, 2003)

Regional Air Quality

The primary sources of air pollutants in coastal areas include stationary sources, area sources, mobile sources, and biogenic sources such as forest fires. Many VOCs react with sunlight in the atmosphere to produce ozone (i.e., smog). In some areas, background levels of air pollutants are relatively high due to air currents depositing pollution from sources outside of the coastal area.

The EPA recently conducted a national-scale assessment of 33 air pollutants (a subset of 32 HAPs plus diesel PM), including sources, ambient concentrations, and human health risk (cancer and noncancer). Many of the highest-ranking 20 percent of counties in terms of risk are located in the Pacific coastal areas in central and southern California. (EPA, 1996)

There is a large area along the Pacific coast, particularly in southern California that is in non-attainment for ozone (ranging from severe to extreme). Non-attainment for ozone is found within all of the air basins along the southern California coast. Los Angeles and Orange counties are in extreme non-attainment for ozone. Ventura and San Diego counties are in serious and severe non-attainment for ozone, respectively, and Santa Barbara County is in moderate non-attainment. Several factors contribute to this including

- Increases in industrial and automotive activity associated with population growth,
- Stagnant air movement,
- Strong inversions during warm weather, and
- Pollutants migrating from neighboring areas.

There are also many areas along the Pacific coast that are in non-attainment for PM_{10}. A large area in southern California is in severe non-attainment for PM_{10}, while smaller areas are in moderate non-attainment in coastal Oregon and Washington. (EPA, 2003f)

The EPA has designated the near shore areas of southern California as unclassified/attainment areas. Due to the lack of major emissions sources in the area and the presence of strong northeast winds, the likelihood of pollutants remaining in the ambient air is low.

The European Union eight-hour air quality standard for ozone (53 nmol/mol) is exceeded throughout the summer in the entire Mediterranean region. Typical ozone mixing ratios in summer are 55 to 70 nmol/mol, and the diurnal variability is small (approximately 10 percent). In addition, the concentrations of aerosols are high. The fine aerosol fraction (less than1micrometer) is composed mainly of sulfate (35 to 40 percent), organics (30 to 35 percent), ammonium (10 to 15 percent) and black carbon (five to 10 percent) and is produced mostly by fossil fuel and biomass combustion. The persistent northerly winds in summer carry large pollution loads from Europe to the Mediterranean Sea, affecting water quality and contributing to eutrophication.

Aerosols further influence the Mediterranean atmospheric energy budget by scattering and absorbing solar radiation. They reduce solar radiation absorption by the sea by about ten percent and they alter the heating profile of the lower troposphere. As a result, evaporation and moisture transport, in particular to North Africa and the Middle East, are suppressed. Furthermore, aerosols interfere with the cloud microstructure and convection, which may lead to decreased precipitation.

There is a remarkably high level of air pollution from the surface to the top of the troposphere (up to 15 kilometers [nine miles] altitude). The strongest anthropogenic influence was observed in the lower four kilometers (two miles), originating from both West and East Europe transported by the northerly flow. Major sources of air pollution along the Mediterranean coast include industrial activity, traffic, forest fires, and agricultural and domestic burning. Because the Mediterranean region has very few clouds in summer, solar radiation levels are high so that noxious reaction products such as ozone and peroxyacetyl nitrate are formed in photochemical smog.

At higher altitudes, above four kilometers (two miles), significant contributions from long-distance pollution transport from North America and Asia are present. About half of the mid-tropospheric CO over the Mediterranean originates from Asia and 25 to 30 percent from North America. These transports follow the prevailing westerly winds that are typical of the extra-tropics. These layers are affected substantially by ozone that is mixed from the stratosphere. The middle troposphere, in particular, is influenced in summer by stratosphere-troposphere exchange, leading to a stratospheric contribution to column ozone in the troposphere up to 25 to 30 percent. Transport of anthropogenic ozone and its precursor gases from the U.S. exert a significant influence in the free troposphere.

A distinct layer that is associated with high levels of reactive species such as formaldehyde is found in the upper troposphere (above eight kilometers [five miles] altitude). This layer of pollution is caused by anthropogenic emissions transported from South Asia, following convective lifting into the upper troposphere by thunderstorms in the Indian monsoon. Subsequently these air parcels follow the easterly tropical jet and turn north over the eastern Mediterranean in a large upper level anticyclone. The chemical "fingerprint" of biomass burning (e.g., enhanced acetonitrile, methyl chloride, acetylene), in particular by biofuel use in India as observed during the Indian Ocean Experiment, is evident. From the upper troposphere over the eastern Mediterranean these substances can penetrate the lowermost stratosphere. It appears that the Mediterranean region is a preferred location for cross-tropopause exchanges, partly related to direct convective penetration of the lower stratosphere over southern Europe. (Lelieveld, 2002)

Existing Emission Sources

The southern U.S. Pacific coast has intensely populated areas with heavy urban development. Heavy industrial activities, high automobile traffic, and energy generation are the main sources of air pollutants in this area. The South Coast Air Basin includes a population that accounts for 40 percent of the traveled vehicle miles and creates one-third of the air pollution in California. The main emission source in this area is automobiles. However, continued construction and development is causing increased fugitive dust levels resulting in growing PM_{10} concentrations.

Emission sources in the south central coastal area include power plants, oil extraction and refining activities, transportation, and agriculture. Ozone concentrations in this district are improving, but the area still struggles with high PM_{10} levels.

Existing air emissions in the near shore environment include emissions from aircraft operations, missile/target operations, and marine vessel operations.

Power plants and transportation provide the greatest sources of global warming gases emissions in Europe, including the southern regions of the Mediterranean Biome. Electricity demand continues to rise in the European Union, securing the presence of CO_2 as a growing emission, with emission levels possibly rising to 23 percent over their 1995 levels by 2020. Emissions of polyaromatic hydrocarbons are another pollutant of concern, deriving primarily from combustion processes in the region, especially in small boilers with often poor combustion. Road traffic is another contributor.

The European Union also pays special attention to hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride as global warming contributors. They are primarily emitted from refrigeration practices, air conditioning (including in cars), and industry. Emissions of each of these three gases have been on the rise lately due to their substitution for ozone depleting substances banned by the Montreal Protocol. (Acid News, 2003)

While most Mediterranean countries studied are not big polluters, the Mediterranean region is a crossroads area for pollution carrying air currents from Europe, Asia, and North America. (Lelieveld, 2002) In fact, studies show that trans-Atlantic pollution transport from North America exerts the greatest influence over the Mediterranean region. (Bey and Schultz, 2003)

The main sources of atmospheric pollution in Northern Africa are bush fires, vehicle emissions, manufacturing, mining, and industry. Major industrial sources include thermal power stations, copper smelters, ferro-alloy works, steel works, foundries, fertilizer plants, and pulp and paper mills. The use of leaded fuel in vehicles also greatly contributes to emissions, which are worsening due to the ageing of the region's vehicles, most of which are more than 15 years old. These older vehicles also are said to emit five times more hydrocarbons and CO, and four times more NO_X, than new vehicles. (United Nations Environment Programme [UNEP], 2000)

H.4.2 Airspace

Controlled and Uncontrolled Airspace

The Chaparral Biome in the U.S. contains all FAA classifications for airspace, as described in Section 3.1.2. Airspace in coastal regions of North America contains "North American Coastal Routes," which are numerically coded routes preplanned over existing airways and route systems to and from specific coastal fixes. See Section 3.1.2 for a description of North American Routes.

Portions of the Chaparral Biome are located in international airspace. Therefore, the procedures of ICAO (outlined in ICAO Document 444, Rules of the Air and Air Traffic Services) are followed. The ICAO is a specialized agency of the United Nations whose objective is to develop the principles and techniques of international air navigation and to foster planning and development of international civil air transport. The FAA acts as the U.S. agent for aeronautical information to the ICAO, and the Los Angeles ARTCC manages air traffic in the California portion of the Chaparral Biome.

In December of 2002, the European Union adopted the "single sky" directive, which will create a single European airspace by 2004. The single sky proposal will eliminate many of the national boundaries that currently divide Europe's airspace to create several "functional blocks of airspace" that will be regulated as a single entity. European Union airspace above 8,687 meters (28,500 feet) will be under unified control.

Special Use Airspace

There are numerous restricted areas in the near shore environment associated with the Western Range. These include restricted areas R-235A and R-2535B, and eight warning

areas (W-289, W-289N, W-290, W-412, W-532, W-537, W-60, W-61). The airspace in each warning area extends from the surface (sea level) to an unlimited altitude. The FAA Los Angeles ARTCC controls civil aircraft operating under IFR clearances and transiting areas associated with the Western Range along the U.S. Pacific Coast. Aircraft operating under VFR conditions are not precluded from operating in the Warning Area airspace; however, during hazardous operations every effort is made to ensure that non-participating aircraft are clear of potential hazard areas.

The procedures for scheduling each portion of airspace are performed in accordance with letters of agreement with the controlling FAA facility, Los Angeles ARTCC. Schedules are provided to the FAA facility as agreed between the agencies involved. Aircraft transiting the open ocean portion of the region of influence that could be affected by tests events would be notified, and any necessary rerouting would be accommodated before departing their originating airport. This may require affected aircraft to take on additional fuel before take-off.

Airports/Airfields

Numerous airports and airfields exist within the Chaparral Biome. For example, the area that encompasses the Vandenberg AFB includes the Santa Barbara Municipal, Santa Ynez, Lompoc, and Santa Maria Public airports. Vandenberg AFB also maintains its own runway, which is capable of handling large aircraft (U.S. Army Space and Missile Defense Command, 2002b).

En Route Airways and Jet Routes

Numerous jet routes that cross the Pacific pass through the U.S. Chaparral Biome, including A331, A332, A450, R463, R465, R584, Corridor V506 and Corridor G10.

H.4.3 Biological Resources

Vegetation

Chaparral Biome occurs in mild temperate climate zones with moderate winter precipitation and long, hot, dry summers or where there is moderate precipitation, but the sandy soils have low water-holding capacities. The Chaparral supports a broad variety of xeric (requiring little water) woodlands from piñon-juniper woodlands to pine barrens to sandhill pine woodlands, sandpine scrub, and pine flatwoods. The vegetation of the Chaparral is characterized by the presence of Sclerophyllous (hard, tough, evergreen) leaves and low, shrubby appearance. Many plants are specially adapted to areas of nearly toxic, magnesium-rich soil (known as serpentine).

Due to the summer drought, many plants that thrive in other European areas are unable to thrive on the Mediterranean Coast. Shrubs and low-growing vegetation are the main components of the region. However, some areas exhibit growth that extends to larger trees and hard-leaf forests, as well as aromatic plants. The vegetation is hardy and drought-resistant and includes evergreens, cacti, olive and fruit trees, and cork oak. Plants with small hard needles or small leathery leafs thrive in this region. Plants have adapted by storing water through thick bark or waxy coverings, and by growing thorns to prevent animals from eating them. Adaptations also include regeneration after fire. Aromatic plants and herbs grow well in this region. These aromatics contain highly flammable oils that sometimes contribute to forest fires.

Wildlife

Several bird species nest and hunt for insects in the Chaparral Biome, including the endangered California gnatcatcher and Costa's hummingbird. Birds of the Chaparral include the endangered California gnatcatcher (*Polioptila californica*), California thrasher (*Toxostoma redivivum*), western scrub jay (*Aphelocoma californica*), and cactus wren (*Campylorhynchus brunneicapillus*).

The near shore and coastal area of the Chaparral Biome may support several Federally listed threatened or endangered species. Exhibit H-7 contains examples of listed threatened or endangered species within the Chaparral Biome.

Exhibit H-7. Federally Listed Threatened or Endangered Species within the Chaparral Biome

Common Name	Scientific Name	Federal Status
Western snowy plover	*Charandrinus nivosus*	Threatened
California brown pelican	*Pelecanus occidentalis californicus*	Endangered
California least tern	*Sterna antillarum broni*	Endangered
Green sea turtle	*Chelonia mydas*	Threatened
Loggerhead sea turtle	*Caretta caretta*	Threatened
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Olive ridley sea turtle	*Lepidochelys oliveacea*	Threatened
Southern sea otter	*Enhydra lutris nereis*	Threatened
Guadalupe fur seal	*Arctocephalus townsendi*	Threatened

Modified from U.S. Army Space and Missile Defense Command, 2003

The Western snowy plover (*Charandrinus nivosus*) is federally listed as threatened and breeds along the Pacific coast from southern Washington State to southern Baja California, Mexico. The plover nests and forages year round on the beaches and intertidal zone of San Nicolas Island which has been designated as critical habitat for the plover. Twenty-eight locations along the California coast have been designated as critical habitat for the plover. Threats to the plover include shoreline modification,

recreational activities such as off-road vehicles and beach combing, and loss of nesting habitat. (Sacramento Fish and Wildlife Service, 2003)

The California brown pelican (*Pelecanus occidentalis californicus*) is federally and state listed as endangered and breeds in nesting colonies on islands that are free from mammal predators. The nesting colonies range from Baja California to West Anacapa and Santa Barbara Islands. The breeding season is from March to August. Brown pelicans may roost along the Pacific coast from the Gulf of California to Washington State and southern British Columbia. Threats to the California brown pelican include a decline in the food supply because of over-fishing, entanglement with hooks and fishing lines, disturbances at roosting sites, disease, and climate changes. (Sacramento Fish and Wildlife Service, 2003)

The California least tern (*Sterna antillarum browni*) is federally and state listed as endangered and is a highly migratory species that is present in California from April to September. It migrates further south during the winter. The least tern nests on sandy beaches close to lagoons and forages in the near shore waters. Threats to the California least tern include habitat loss, human disturbance, predation, and climatic events. (Sacramento Fish and Wildlife Service, 2003)

The Green sea turtle (*Chelonia mydas*) is a federally threatened sea turtle found in the eastern North Pacific from Baja California to southern Alaska. Green sea turtles forage in the kelp beds off western San Nicolas Island but there are no known nesting locations on the island. The sea turtles are sighted year round in the Western Range generally in waters less than 50 meters (164 feet) deep. Populations appear to be highest from July to September. Threats to the Green sea turtle include over-harvesting by humans, habitat loss, fishing net entanglement, boat collisions, and disease. (Sacramento Fish and Wildlife Service, 2003)

The Loggerhead sea turtle (*Caretta caretta*) is a federally threatened sea turtle similar to the Green sea turtle. It has been observed in the Range at depths up to 1,000 meters (3,280 feet). Juvenile Loggerhead sea turtles are spotted frequently in the Western Range particularly from July to September but adult Loggerheads are rarely seen in the Western Range. Threats to Loggerhead sea turtles include exploitation, loss of habitat, fishing practices, and pollution.

The Leatherback sea turtle (*Dermochelys coriacea*) is a federally listed endangered species. The Leatherback sea turtle is a highly migratory species and is more pelagic (using deep ocean waters) than other sea turtle species. They may forage in the kelp beds off western San Nicolas Island, but there are no known nesting beaches on the island. They have been observed in the Western Range at depths of up to 1,000 meters (3,280 feet). They are most common from July to September. Threats to the Leatherback sea turtle include exploitation, loss of habitat, fishing practices, and pollution.

The Olive ridley sea turtle (*Lepidochelys oliveacea*) is a federally listed threatened species. (NOAA, 2003a) The Olive ridley is primarily tropical, nesting from southern Sonora, Mexico to Colombia. These turtles are rarely seen in the waters off the southwestern U.S. They have been observed in the Western Range in waters less than 50 meters (164 feet) but are rarely encountered.

The Southern sea otter (*Enhydra lutris nereis*) is federally listed as threatened. The sea otter lives in shallow water along the shores of the North Pacific. Sea otters inhabit intertidal and shallow, subtidal zones often in kelp beds. Sea otters can be found throughout the year in the kelp beds at the west end of San Nicolas Island and in smaller numbers off the north end of the island. Threats to the sea otters include shootings, boat strikes, capture and relocation, oil spills, and exposure to other toxic contaminants.

The Guadalupe fur seal (*Arctocephalus townsendi*) is federally listed as threatened. Individuals have been observed in the southern Channel Islands, including San Nicolas Island. The decline in the species appears to have been due to historic commercial hunting.

Environmentally Sensitive Habitat

The Chaparral Biome around the world supports 20 percent of all plants, but these areas are all relatively small and highly threatened. For example, the California Chaparral is one of only five Chaparral shrublands and woodlands of its kind and is the only one in North America. The biggest problem for this habitat is agricultural and urban expansion, which destroys and fragments remaining patches of Chaparral. Smaller patches also experience higher impacts from introduced plants and animals. Small patches also lose species that require larger areas of habitat for survival. In addition, fire suppression causes fuels to build up and can trigger very hot, devastating fires.

In 1980, a 4,294-square kilometers (1,252-square nautical miles) portion of the Santa Barbara Channel was designated as the Channel Islands National Marine Sanctuary. The sanctuary is an area of national significance that encompasses the waters that surround Anacapa, Santa Cruz, Santa Rosa, San Miguel and Santa Barbara Islands and extends from mean high tide to 11 kilometers (six nautical miles) offshore around each of the five islands. The sanctuary's primary goal is the protection of natural resources contained within its boundaries. The NOAA plans to expand the Channel Islands National Marine Sanctuary off the coast of Vandenberg AFB. The study area for this expansion includes an area off the coast of California from south of Point Mugu to north of Point Sal. (NOAA, 2003a)

Essential Fish Habitat includes those waters and sediment that are necessary to complete the life cycle for fish from spawning to maturity. The two Essential Fish Habitat zones in this region are for coastal pelagic and groundfish species. The coastal pelagic species

include Pacific sardine (*Sardinops sagax*) Pacific mackerel (*Scomber japonicus*), northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), and squid. The groundfish species include rockfish, shark, and cod. Migratory fish species in the area include tunas, marlin, and swordfish (*Xiphias gladius*). The east-west boundary for the Essential Fish Habitat zone includes all marine and estuary waters from the coast of California to the limits of the Exclusive Economic Zone (322 kilometers [200 miles]) where the U.S. has authority over the management of fisheries.

H.4.4 Geology and Soils

Geology

The California Chaparral Biome consists of narrow ranges with wide plains in between, as well as alluviated lowlands and coastal terraces. Elevation ranges from zero to 2,280 meters (zero to 7,500 feet).

In the Mediterranean region, the African plate pushes northward, causing the plate to move beneath, or subduct, European countries along the north coast of the Mediterranean. Many of these countries are known for their mountains and volcanoes, a result of this continuing process. There are many points of convergence and subduction throughout the Mediterranean, making it a distinctly geologically active region. Tectonics explains the size of the mountains around the Mediterranean Basin. Recent, high mountains with rough-hewn shapes rise either on the sea or a few kilometers inland. The main mountain ranges are the Atlas, the Betic chain, the Pyrenees, the Alps, the Apennines, the Dinaric massif, the Pinde mountains, the Taurus, and Mount Lebanon. In the northern part of the Mediterranean Basin, large plains are infrequent. However, in the southern part, along the thousands of kilometers of coastline, mountains are replaced by usually flat stretches where the desert often runs to the sea. (UNEP, 2003)

Soils

The soils of the Chaparral Biome may be classified into four categories, coastal beach sands, tidal flats, loamy sands, and silty clay. The erosion hazard of these soils depends on slope and vegetation cover.

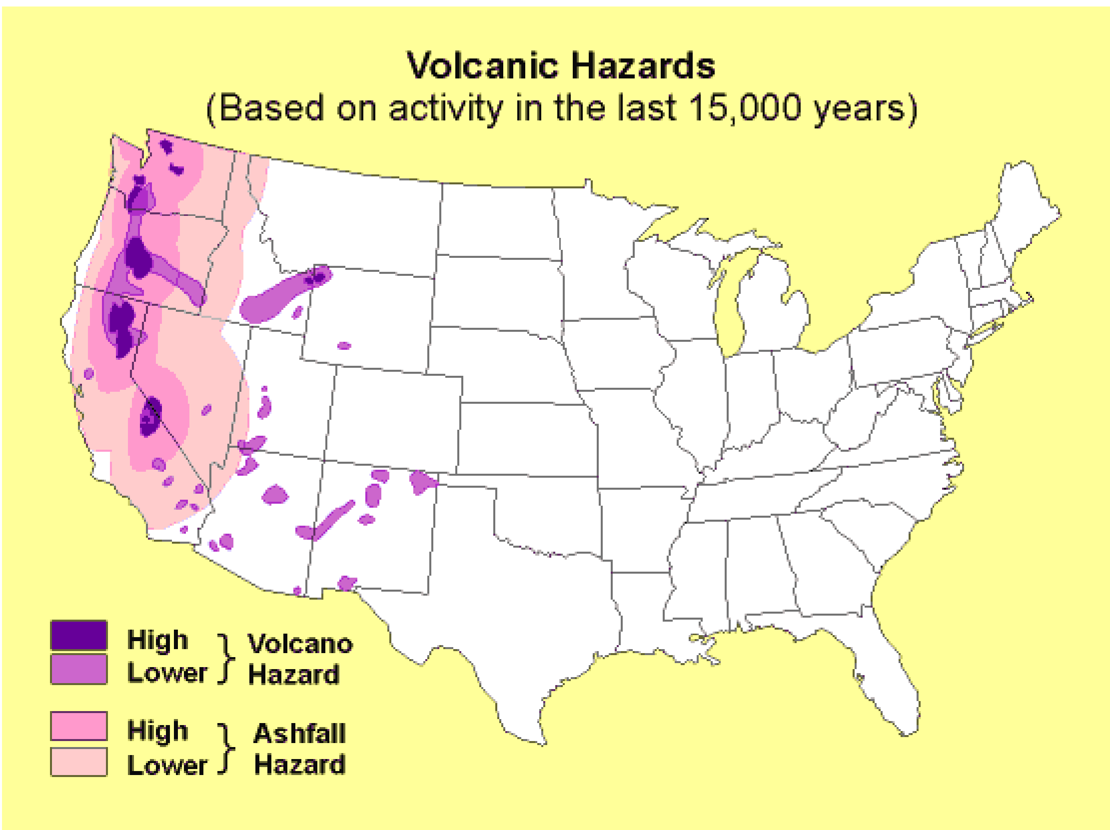
In addition, the soils of the north Mediterranean Basin, where the climate is more humid, contain plant matter, which breaks down faster into soils rich in organic matter. In the southern Mediterranean Basin, because of extreme temperatures and lack of water, soils become depleted in organics, leaving behind a higher concentration of minerals. In addition, organics are removed by encroaching seawater along the coast that can cause salinization of soils. These soils, which are sensitive to desertification, become shallow and have a low water-holding capacity. (UNEP, 2003) Mediterranean soils are subject to intense erosion due to irregular and often violent precipitation such as monsoons, wind,

the steep topography, and reduction in plant cover caused by the severe climate and man-made activities. (UNEP, 2003)

Geological Hazards

The California Chaparral Biome is noted for its intense seismic activity due to the right lateral motion of the Pacific and North Atlantic Plate boundary. Fault activity can cause damage in a variety of ways, and hazards include landsliding, ground shaking, surface displacement and rupture, and the triggering of tsunamis. In general, the type of damage sustained at a particular location depends on the proximity to the active faults, the frequency and severity of the disturbance, the potential for surface rupture, the composition of the surface and subsurface materials, and topography. Exhibit H-8 shows the geological hazards found in the U.S. Chaparral Biome.

Exhibit H-8. Volcanic Hazards (based on activity in the last 15,000 years)



Source: USGS, 2002c

Darker shaded areas show regions at greater or lesser risk of local volcanic activity, including lava flows, ashfalls, lahars (volcanic mudflows) and debris avalanches, based on the record of the last 15,000 years, as compiled by Mullineaux (1976). Lighter shaded

areas show regions at risk of receiving five centimeters (two inches) or more of ashfall from large or very large explosive eruptions, originating at the volcanic centers. These projected ashfall extents are based on observed ashfall distributions from an eruption (large) of Mt. St. Helens that took place 3,400 years ago, and the eruption of Mt. Mazama (very large) that formed Crater Lake, Oregon, 6,800 years ago.

H.4.5 Hazardous Materials and Hazardous Waste

Hazardous Materials

Hazardous materials use within the Chaparral Biome must conform to applicable Federal, state and local laws and regulations. Existing ranges located within the U.S. Chaparral Biome have established procedures for obtaining hazardous materials from off-base suppliers. Hazardous materials are tracked using Environmental Management System software. These procedures are in accordance with the Hazardous Materials Management Plan. Spills of hazardous materials are covered under the Hazardous Materials Emergency Response Plan. This plan ensures that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to all installation personnel.

Hazardous Waste

Hazardous waste would be handled through established procedures, which describe procedures for packaging, handling, transporting, and disposing of hazardous waste. Hazardous wastes are typically collected at the point of generation and, if not reused or recycled, transported to a collection-accumulation point. Following initial containerization, waste may remain at the collection-accumulation point for up to 90 days, at which point all hazardous waste must be transported to the off-site Treatment, Storage, and Disposal Facility (U.S. Army Space and Missile Defense Command, 2001).

H.4.6 Health and Safety

Health and Safety attributes of the Chaparral Biome are similar to those discussed in Section H.1.6.

H.4.7 Noise

Vandenberg AFB is a representative example of noise levels for sites where activities for the proposed BMDS may occur in the Chaparral Biome. Ambient noise levels at Vandenberg AFB range from 48 to 67 dBA. (DOT, 2001) Noise sources associated with the proposed BMDS are described in Section H.1.7.

H.4.8 Transportation

Coastal areas sustain widespread infrastructure, including marine ports and docks that are supported by traffic circulation systems such as highways and byways, unpaved roads, non-maintained roads, trails, railroad lines, municipal, private, and military airports and any other system involved in mass transportation.

Ground Transportation

For example, at Vandenberg AFB, California, on-site roadways provide access to launch complexes, support facilities, and industrial areas, and significant delays seldom occur. Several off-site roads and major highways provide access to the installation. Railways transport both cargo and passengers in the region.

Air Transportation

There are numerous commercial, private, and military airports within the Chaparral Biome. They vary in size from major international airports such as Los Angeles International Airport in Los Angeles, California that supports 55 million passengers each year to small, rural airstrips that support single engine planes.

Marine Transportation

The top ports in U.S. foreign trade are deep draft (with drafts of at least 12 meters [40 feet]). Two major U.S. ports are located within the Chaparral Biome, including San Diego and Los Angeles, California. Once a shipping vessel leaves the navigation lanes leading to sea, there are no regulations or directions obliging commercial vessels to use specific cross-ocean shipping lanes. NOTMARs can be issued to warn vessels of testing events occurring in this area.

H.4.9 Water Resources

Surface Water and Ground Water Resources

Very few perennial streams occur in the Southern California coastal area. Perennial and intermittent streams occur in alluvial and weak bedrock channels that flow directly to the Pacific Ocean. High velocity and quantity flows periodically occur in the numerous intermittent drainages.

There is relative scarcity, on a per capita basis, of freshwater supplies in Mediterranean regions, where agriculture competes for freshwater with growing tourism and industrial use. (UNEP Plan Bleu, 2000) In coastal and marine areas, urban and industrial development and tourism have resulted in growing pressures on already hard-pressed

areas. Parts of the Mediterranean Sea are affected by high nutrient inputs, coastal degradation, over-fishing, and the disposal of plastics. (UNEP, 1999)

Drinking water production represents only a small part of the total quantity of water mobilized and used in the Mediterranean region (15 to 20 percent in the developed countries to the North; less than ten percent in countries with a high demand for irrigation water). For example more than 80 percent of the population in Mediterranean Countries has access to drinking water. (Margat and Vallée, 1999)

Water Quality

Major water nutrients in the near shore environment include dissolved nitrogen, phosphates, and silicates. Dissolved inorganic nitrogen occurs as nitrates, nitrites, and ammonia, with nitrates being most common. The nitrate concentration of water in the near shore environment varies annually from 0.1 to 10.0 micrograms per liter with the lowest concentrations occurring in the summer months. At a depth of 10 meters (33 feet), concentrations of phosphate and silicate in the near shore environment range from 0.25 to 1.25 micrograms per liter, respectively.

The Clean Water Act prevents the release of hazardous substances into or upon U.S waters out to 370 kilometers (200 nautical miles) from the shore. Shipboard waste handling procedures for commercial and U.S. Navy vessels govern the discharge of non-hazardous waste.

H.5 Grasslands Biome

As shown in Exhibit 3-15, the Grasslands Biome includes the grasslands biomes of North and South America, Eurasia, and Australia (see Exhibit 3-15). The description in this section is representative of this biome throughout the world. Currently there are no active sites in the Grasslands Biome where proposed activities for the BMDS might occur; however, past military installations within this biome make it reasonably foreseeable that future activity for the proposed BMDS could occur here. There are no coastal sites located in the Grasslands Biome.

H.5.1 Air Quality

Climate

Grasslands can be found in the middle latitudes, spanning from 55 degrees north to 30 degrees south within the interiors of continents. Grasslands in North America are known as Prairies, and those in Eurasia are called Steppes.

In the Grasslands Biome, approximately 25 to 76 centimeters (ten to 30 inches) of precipitation falls annually, while in May, June, and August, some regions may receive

up to ten to 12 centimeters (four to five inches) of precipitation per month. Northern grasslands often receive large quantities of snowfall. The temperature varies due to the vast latitudinal span of the grasslands, with annual temperatures ranging from -20°C to 43°C (-4°F to 104°F). The average annual temperature across the Grasslands Biome is 24°C (43°F).

The low humidity of the Grasslands Biome arises because mountain barriers block warm, moist air from oceans. For example, in the U.S, the Rocky Mountains block moistures from the Pacific Ocean, which dry grassland areas in the interior of the country where summers are hot and dry and winters are very cold. The mean temperatures for the U.S. prairies are -7ºC and 21ºC (20ºF and 70ºF) for January and July, respectively. In Eurasia, warm, moist air from the Indian Ocean is blocked by the Himalayas creating dry grassland areas in the Eurasian steppes. There are, however no barriers to block arctic winds in the Eurasian steppes, therefore, winters are extremely cold and windy. Winter temperatures in this region can reach as low as -40°C (-40°F), while summer temperatures may reach 21°C (70°F). A lack of natural barriers, such as trees, results in constant, often violent, winds throughout the Grasslands Biome. Erratic precipitation and hot summer temperatures cause drought and fire, which prevent the growth of large forests.

Regional Air Quality

Air quality over the plains of the U.S. is regulated by EPA Regions 5, 6, 7, and 8. The locations of non-attainment areas within the U.S. Grasslands Biome are indicated in Exhibit 3-2. The European Union monitors ambient air quality through its 1996 Framework Directive 96/62/EC. This directive sets limits and/or threshold values for the above pollutants as a concentration of the pollutant by mass per volume of air, as well as provides guidance for ambient air quality assessment and management.

Air pollution issues of special concern to the Grasslands Biome are emissions from open burning and fugitive dust. Open burning frequently occurs in rural areas to eliminate noxious weeds or crop-damaging pests/insects in agricultural fields and to dispose of household waste. Further, because dry grasslands may experience periods of drought and high winds, fugitive dust, such as dust from mining or construction activity, gravel roads or wind erosion from agricultural fields, may be kicked up and circulated in the atmosphere, and may travel long distances due to the lack of natural barriers. (South Dakota Department of Environment and Natural Resources, 2003)

Existing Emission Sources

Due to the low population density of most grassland areas, biogenic (naturally occurring) activities are the predominant sources of air pollution emissions in this biome.

Agriculture produces a variety of non-methane VOCs from livestock and crop sources that contribute to the production of secondary pollutants, such as ozone, which in turn damages crops and natural fauna. N_2 also is produced from aerobic vegetative processes, anaerobic soil activity, and through animal excretion. Ammonia emissions are likewise attributed to livestock wastes. Ruminant animals (e.g., cows) exhale dimethyl sulfide, which oxidizes to sulfuric acid that contributes to the formation of acid rain.

Anthropogenic sources of emissions in the Grasslands Biome may include industrial activity, electricity generation and transmission, and traffic in metropolitan areas.

H.5.2 Airspace

Controlled and Uncontrolled Airspace

The Grasslands Biome in the U.S. contains all FAA classifications for airspace, as described in Section 3.1.2. The appropriate ARTCC would control civil aircraft operating under IFR clearances within the biome.

In December of 2002, the European Union adopted the "single sky" directive, which will create a single European airspace by 2004. The single sky proposal will eliminate many of the national boundaries that currently divide Europe's airspace to create several "functional blocks of airspace" that will be regulated as a single entity. European Union airspace above 8,687 meters (28,500 feet) will be under unified control.

Special Use Airspace

For restricted airspace or established Warning Areas, aircraft operating under VFR conditions are not precluded from operating in these areas; however, during hazardous operations every effort is made to ensure that non-participating aircraft are clear of potential hazard areas. Examples of restricted airspace occurring within the Grasslands Biome include the R-5401 Restricted Area southeast of Devils Lake in the Devils Lake East MOA, the Tiger North and Tiger South MOA, and the Devils Lake East and Devils Lake West MOA in the U.S. IFR Military Training Routes occurring in the Grasslands Biome are designated such that the military assumes responsibility for separation of aircraft operations established by coordinated scheduling. (U.S. Army Space and Missile Defense Command, 2000)

Airports/Airfields

Civilian, military, and private airports exist in the Grasslands Biome.

En Route Airways and Jet Routes

Civilian aircraft generally fly along established flight corridors that operate under VFR. Numerous Minimum En route Altitudes are present in the Grasslands Biomes. The airway and jet route segments in this Biome lie within airspace managed by the Minneapolis ARTCC.

H.5.3 Biological Resources

Vegetation

Latitude, soil, and local climates determine what kinds of plants grow in particular grasslands. Short grasses, which are predominant throughout the Grasslands Biome, have adapted physiological responses to widespread drought and fire. Grasses can survive fires because they grow underground storage structures for holding vital nutrients and because they grow from the bottom, slightly below ground surface, rather than from the top. Therefore, their stems can grow again after being burned off.

Wildlife

Wildlife in the Grasslands Biome varies from amphibians and reptiles to a variety of small mammals (field mice, voles, prairie dogs) to a host of avian species, including migratory species. Some of resident and migratory species rely on ephemeral prairie potholes that exist in the Grasslands Biome. Many endangered or threatened animals are found in the Grasslands Biome. In the U.S., the Whooping crane (*Grus americana*) is endangered, and the Piping plover (*Charadrius melodus*) is threatened. Naturally occuring grasslands are becoming harder to find due to human encroachment that can be attributed to increasing population pressures, desire for farmland, and oil exploration, among others.

Environmentally Sensitive Habitat

Critical habitat for the Whooping Crane has been designated in the states of Colorado, Idaho, Kansas, Nebraska, New Mexico, Oklahoma, and Texas. Critical habitat is designated for wintering grounds for the Piping Plover, including units in Texas. The USFWS has proposed areas for critical habitat designation throughout other plains states, yet no final rule has been promulgated.

Kelly's Slough Wildlife Management Area is located approximately three kilometers (two miles) east of Grand Forks AFB, a former installation located in this biome. This 656-hectare (1,620-acre) wetland area, managed by the USFWS, is a stopover for migratory waterfowl. Wetlands occur in drainage-ways, low-lying areas, and potholes. Approximately 10 hectares (24 acres) of wetlands were identified within the boundary of

Grand Forks AFB. An additional 73 hectares (180 acres) are located east of the main base and are associated with four sewage lagoons. Several small prairie potholes on Grand Forks AFB support non-forested wetlands. (U.S. Army Space and Missile Defense Command, 2000)

H.5.4 Geology and Soils

Geology

The majority of the Grasslands Biome in the U.S. is part of the North American craton, which is an area that has been tectonically stable throughout most of geologic time. The area includes crystalline Precambrian rocks that underlie Paleozoic and younger sedimentary rocks, which in some areas are covered by glacial sediments. Precambrian rocks are exposed only in the St. Francois Mountains of southeastern Missouri, where they are locally more than 1,000 feet above sea level; these rocks are buried to depths of as much as 6,000 feet below sea level in southwestern Kansas on the northern flank of the Anadarko Basin. (USGS, 1997)

Post-depositional erosion of the Paleozoic sedimentary-rock sequence from eastern Missouri to central Kansas and eastern Nebraska has beveled off some of the rocks. As a consequence, progressively younger rocks are exposed to the west and northwest of the Precambrian core of the St. Francois Mountains in southeastern Missouri. The glacial sediments cover portions of the bedrock strata in eastern Nebraska, northeastern Kansas, and northern Missouri, and stream-valley deposits are prevalent along the major streams and some secondary streams. The widespread areas of Tertiary and Quaternary sediments in western Kansas and Nebraska are not related to erosion or beveling of rocks away from the St. Francois Mountains and the Ozark Uplift. These Tertiary and Quaternary sediments are mostly alluvium that was derived from erosion of the Rocky Mountains to the west of the segment. (USGS, 1997)

The Tertiary and Quaternary deposits are the most widespread geologic unit in the Grassland Biome and are especially prominent in Kansas and Nebraska. They are characterized mainly by unconsolidated sand and gravel, but locally include beds of sandstone, siltstone, silt, and clay. Various other geologic formations present in the Grasslands Biome include Cambrian rocks (sandstones and dolomite), Ordovician rocks (dolomite and limestone interbedded with minor sandstone and shale), Silurian rocks (a thin sequence of dolomite and limestone), Devonian rocks (limestone interbedded with minor sandstone and chert) Mississippian rocks (limestone (commonly cherty) but include some beds of sandstone and shale), and Pennsylvanian strata crop (shale, sandstone, limestone, and some coal beds). Other geologic formations that are present in the biome, but to a lesser extent include Permian rocks (shale and sandstone but also contain beds of halite (rock salt), gypsum, anhydrite, and minor limestone), and Triassic

and Jurassic rocks (shale, siltstone, and dolomite), Cretaceous rocks (consist largely of shale, with some widespread sandstones). (USGS, 1997)

Soils

Grasslands typically consist of flat to rolling terrain with open fields and meadows carpeted by deep-rooted grasses and sparse trees. The soil of most grasslands is too thin and dry for trees to survive. Grasses with deep root systems keep the soil from blowing away. The predominant soil type found throughout the Grasslands Biome is characterized by a thick, dark surface horizon resulting from the long-term addition of organic matter derived from plant roots. This type of soil occupies roughly 21 percent of the U.S. land area and is some of the most productive agricultural soil in the world. However, where the grasslands are more arid, the soil is characteristically dry most of the year. The soil has accumulated clays, calcium carbonate, silica, and salts. This type of soil occupies roughly eight percent of the U.S. land area and is used mainly for range, wildlife, and recreation. Because of the dry climate in which they are found, they are not used for agricultural production unless irrigation water is available.

Geological Hazards

There are no significant widespread geological hazards within the Grasslands Biome.

H.5.5 Hazardous Materials and Hazardous Waste

Hazardous Materials

Hazardous materials use at ranges within the Grasslands Biome include diesel fuel, gasoline, lubricating oil, thinners, kerosene, solvents, and sulfuric acid. All areas that contain hazardous materials have appropriate Material Safety Data Sheets that provide workers and emergency personnel with the proper procedures for handling or working with a particular substance. (U.S. Army Space and Missile Defense Command, 2000)

Typically, all personnel working with hazardous materials have initial and updated training in Hazard Communication that enables them to identify the hazards of the material. Material Safety Data Sheets are provided with materials or they can be obtained from the Bioenvironmental Engineering Services office or a Pharmacy, a type of facility that would dispense hazardous materials to users.

Hazardous Waste

Missile facilities generate batteries, battery acid, paint and solvent wastes, and sodium chromate solution and rags. When a hazardous material is spilled, spent, or contaminated to the extent that it is not able to be used for its original purpose, or cannot be converted to a usable product, it becomes a hazardous waste. Hazardous wastes can be generated on a continual basis or generated if a spill of a hazardous material occurs. Hazardous wastes also are generated at deployment area facilities. For example, spent sodium chromate solution, rags used to handle the solution, and rags or gloves used to handle sodium chromate are wastes generated during daily routine operations and maintenance of the missile system.

H.5.6 Health and Safety

Health and Safety attributes of the Grasslands Biome are similar to those discussed in Section H.1.6.

H.5.7 Noise

Noise sources associated with the proposed BMDS are similar to those described in Section H.1.7.

H.5.8 Transportation

The plains states of the U.S. have, within the last decade, become a major transportation corridor for the transport of goods between Mexico, the U.S., and Canada, as the North American Free Trade Agreement opened up the conjoining international borders to free trade. Thus, most transportation through the plains is for commercial purposes.

Ground Transportation

Railroads and motor carriage (i.e., trucking) are the backbone of the freight transportation system in the Grassland region. Railroads in the Grasslands region of the U.S. compete with barges for business. The highway system in the prairies consists largely of rural roads, many of which are local roads that are maintained by county and township governments.

Air Transportation

There are numerous commercial, private, and military airports within the Deciduous Forest Biome. They vary in size from major international airports such as Kansas City International that handles around 11 million passengers each year to small, rural airstrips that support single engine planes.

Marine Transportation

In the U.S. Grasslands Biome, the transportation of grains and other agricultural commodities is of utmost importance. Barges haul over half of all U.S. grain shipments to export ports, predominately via the Upper Mississippi River towards the Gulf of Mexico. The Upper Mississippi River is the dominant river for originating barge grain traffic for export, and it originates almost as much grain for exports as all the regional railroads combined. As there are no coastal sites located in the Grasslands Biome, there are no major coastal ports associated with this Biome.

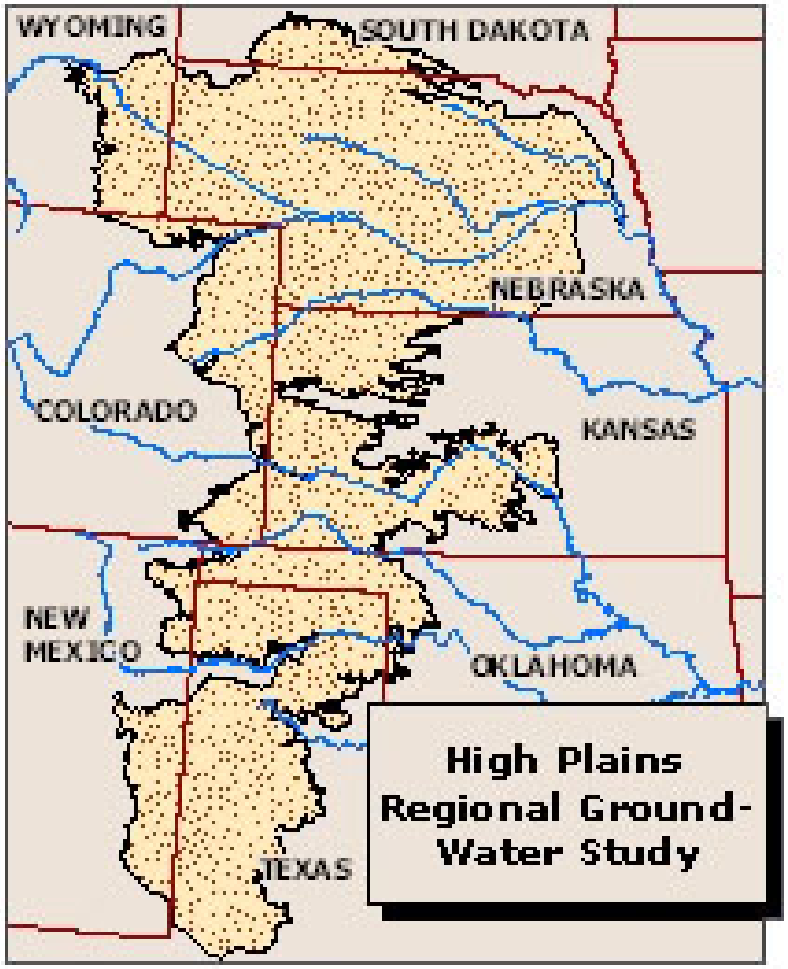
H.5.9 Water Resources

Surface Water and Ground Water Resources

The prairies of the U.S. typically exhibit an arid climate. Therefore, water is an important natural resource. Sources of water in the Grasslands Biome include precipitation, ground water in aquifers, and surface water in rivers, streams, lakes, and wetlands. The High Plains aquifer system, also referred to as the Ogallala Aquifer, underlies 362,102 square kilometers (225,000 square miles) in parts of eight states, as shown in the Exhibit H-9 below. Competing uses for ground water include agriculture, domestic and commercial consumption, recreation, natural ecosystems, and industrial uses (such as cooling water for energy generation and to keep dust down at mining sites, etc.). Agriculture (e.g., irrigation and livestock) is the largest consumptive use category of water in almost all prairie states, accounting for 40 percent of the total water used in most states.

Due to the heavy dependence on underground water systems for irrigation of the plains' extensive farmland (and to a lesser extent for municipal water systems and industrial development), the depletion of the Grassland Biome's aquifers is of special concern. Withdrawal of this ground water has greatly surpassed the aquifer's rate of natural recharge, resulting in a drawdown of the water table. Some areas overlying the aquifer have already exhausted their underground supply as a source of irrigation. States in the South Plains are more affected by the depletion than are the northern states. (Glantz, 1989) Not only does aquifer depletion result in a loss of available water resources, but the overlying land also may subside, disrupting surface drainage, reducing aquifer storage, causing earth fissures, and damaging wells, buildings, roads, and utility infrastructure. (Cyberwest Magazine, 2003)

Exhibit H-9. High Plains Aquifer System



Source: USGS, 2003

Prairie potholes tend to be seasonal water bodies closely associated with wetlands. Prairie potholes are typically filled following the spring snowmelt, although many potholes are situated within a surficial aquifer and retain water throughout the year. Prairie potholes are prime waterfowl production areas that also provide habitat for waterfowl and other species during migratory seasons. (U.S. Army Space and Missile Defense Command, 2000)

Europe abstracts a relatively small portion of its total renewable water resources each year. Total water abstraction in the region is about seven percent of the total freshwater resource. Resources are unevenly distributed across the region, and even if a country has sufficient resources at the national level there may be problems at regional or local levels. Agriculture and cooling for electricity production are the dominant uses of ground and surface water in Europe.

Water Quality

The quality of water in the High Plains aquifer generally is suitable for irrigation use, but in many places, the water does not meet EPA drinking water standards with respect to several dissolved constituents: dissolved solids/salinity, fluoride, chloride, and sulfate. (USGS, 2003) The primary sources of water contamination in the U.S. prairies are agricultural practices (especially non-point source runoff from crop inputs and animal wastes), oil and gas extraction, and industry. Natural conditions, such as low flows, also contribute to violations of standards. (U.S. Army Space and Missile Defense Command, 2000)

The European Union monitors surface water quality and drinking water quality via the 1976 Council Directive 76/160/EEC on Bathing Water Quality and the 1998 Council Directive 98/83/EC on the Quality of Water Intended for Human Consumption, respectively. Due to the outdated content of the former directive, the European Commission adopted a proposal for a revised directive (COM(2002)581) in October of 2002. Though this revision uses only two bacteriological indicators, Intestinal Enterococci and Escherischia coli, it sets a higher health standard than the existing directive.

In the 1970s and 1980s, freshwater, surface water and ground water sources throughout Europe suffered eutrophication when they became flooded with organic matter, nitrogen from fertilizer, and phosphorus from industrial and residential wastewater. In recent decades, however, water quality improvements have been made across Europe. In Central and Eastern Europe, 30 percent to 40 percent of households were not yet connected to sewer systems as of 1990, and water treatment in this area was still inadequate. (UNEP, 2002) (European Union, 1998)

H.6 Desert Biome

The Desert Biome includes the desert regions of North America, which include the western arid environment of the southwestern U.S. (see Exhibit 3-16, Volume 1). The description in this section of the U.S. desert is representative of this biome throughout the world. Existing inland sites in the Desert Biome include WSMR, New Mexico; Fort Bliss, Texas; Edwards AFB, California; and the Nevada Test Site, Nevada. There are no coastal sites located in the Desert Biome.

H.6.1 Air Quality

Climate

Deserts cover about one-third of the Earth. Although deserts may be predominantly hot or cold, all deserts are dry. The two main distinguishing characteristics between different desert types are temperature and degree of aridity. In cold desert regions, temperatures range from 2ºC to 4ºC (36ºF to 39ºF) in the winter and from 21ºC to 26ºC (70ºF to 79ºF) in the summer. These regions usually have larger amounts of precipitation in the winter and spring, followed by a dry season. Total annual precipitation averages 15 to 26 centimeters (six to ten inches). In contrast, hot desert regions have average monthly temperatures above 18ºC (64ºF), with typical temperatures ranging from 20ºC to 25ºC (68ºF to 77ºF). The extreme maximum temperature for hot desert biomes ranges from 44ºC to 49ºC (111ºF to 120ºF). Hot desert regions usually have very little precipitation annually and/or concentrated precipitation in short periods, totaling less than 15 centimeters (six inches) a year.

Existing sites where activities for the proposed BMDS may occur reside within the hot desert biome. Hot desert regions span the equatorial belt from 15 to 28 degrees north and south of the equator, with most of these deserts lying near the Tropic of Cancer or the Tropic of Capricorn. While the characteristics of the desert biome are similar throughout the world, this discussion focuses on the deserts of the western U.S., including parts of California, Utah, Nevada, Arizona, New Mexico, and Texas.

Deserts are characterized by high-pressure zones in which cold air descends. The descending air then becomes warm, but instead of releasing rain, the heat from the ground evaporates the water. Because deserts are dry, they have large daily temperature variations. Temperatures are high during the day because there is very little moisture in the air to block the sun's rays from reaching Earth. As the sun sets, the heat absorbed during the day quickly escapes back into space, resulting in cold nightly temperatures.

Regional Air Quality

A unique pollutant of concern in desert regions is dust, i.e., PM, which contributes to desertification, the process of creating deserts. Activities that expose and disrupt topsoil, such as grazing and agricultural cultivation common throughout the western U.S., can increase the amount of dust released into the air. Dust and other particles in the air cause water droplets in clouds to be smaller. The size of the water droplets in a cloud determines whether gravity will force the droplets towards the earth’s surface, instead of remaining suspended in the air. Therefore, the more dust and other particulates that are suspended in the air, the less rain falls to the earth, thereby enhancing drought conditions and contributing to further desertification. (NASA, 2001)

Regional air quality at WSMR is described as representative of the Desert Biome. Otero County is in attainment for state and Federal standards. Doha Ana County is currently considered to be in attainment with the NAAQS. However, the Air Quality Bureau has recorded exceedances of the standard for PM_{10} in the county. (U.S. Army Space and Missile Defense Command, 2002d)

Existing Emission Sources

As discussed above, the predominant source of air pollution in the Desert Biome is agriculture, which disturbs the surface layer soil and emits dust into the air. Animal excrements are also a source of N_2, ammonia, and non-methane VOCs, which may contribute to the formation of ozone and particulates in the atmosphere. Reduced air quality also can be attributed to natural and man-made fires, as well as to industrial activity.

H.6.2 Airspace

Controlled and Uncontrolled Airspace

The U.S. Desert Biome contains all FAA classifications for airspace, as described in Section 3.1.2. Ranges in the Desert Biome, such as WSMR in New Mexico, may include airspace that may be recalled for purposes such as conducting testing operations. This airspace is controlled by the Holloman AFB radar approach control facility, by agreement with the FAA through the Albuquerque ARTCC. The radar approach control airspace has been divided into five areas for recall purposes when conducting testing operations.

Depending on the airspace and safety requirements of a particular WSMR mission, one or more of these areas can be recalled by WSMR for a specified period of time. WSMR recalls portions of the radar approach control areas for research and development missions, which has the effect of limiting instrument approaches to Holloman from the north, limiting departures to the north directly into WSMR airspace, modifying VFR arrivals from the north, and tightening IFR departures to the southwest. (U.S. Army Space and Missile Defense Command, 2002d)

Special Use Airspace

Ranges within the Desert Biome may contain special-use airspace, which enables the airspace to be utilized for military purposes without interference. For example, the R-5107 complex of special-use airspace covering WSMR was especially chartered to protect non-participating aviation from potentially hazardous military operations, including missile testing. WSMR controls a complex of 19 restricted areas. Any aircraft that have not been authorized and scheduled by the controlling agency are prohibited from entering active restricted airspace. During part of the day, WSMR may return some

of the restricted airspace to FAA control for use by aircraft under a shared-use agreement between WSMR and the FAA. All areas are joint-use except R-5107B, which is in continuous use by WSMR and is not released back to the FAA. Many of the restricted areas are used extensively by Holloman AFB for advanced training missions. (BMDO, 1994)

Airports/Airfields

Civilian, military, and private airports exist in the U.S. Desert Biome to serve different aircraft. General aviation airports are located in Las Cruces and Alamogordo, New Mexico, and El Paso, Texas. The Las Cruces International Airport is used primarily for general and some commercial aviation. The Alamogordo/White Sands Regional Airport is used mainly for general and some commercial aviation. The El Paso International Airport is used primarily for commercial and general aviation. (U.S. Army WSMR, 1998)

En Route Airways and Jet Routes

The airway and jet route segments in the flight corridor at WSMR lie within airspace managed by the Albuquerque ARTCC. This office exercises control of its Class A and B airspace traffic within sectors, dividing the airspace both vertically and horizontally. Some military low-level routes and refueling routes are within the region. (U.S. Army Space and Strategic Defense Command, 1997)

H.6.3 Biological Resources

Vegetation

From a biogeographic perspective, the Desert Biome encompasses three major vegetation types. In order of dominance, these are semi-desert grassland, plains-mesa sand scrub, and desert scrub. In species composition, these three vegetation types correspond to the desert scrub biotic community and the semi-desert grassland biotic community. Grassland habitat merges with desert scrub, creating a complex landscape mosaic. Major vegetation in the desert scrub area includes a combination of woody and herbaceous shrubs such as the Creosote Bush (*Larrea tridentata*), Shadscale (*Atriplex confertifolia*), Winterfat (*Ceratoides lanata*), and White Bursage (*Ambrosia dumosa*). Plains-mesa sand scrub separates semi-desert grassland and desert scrub vegetation. The desert scrub vegetation is divided into broadleaf evergreen and broadleaf deciduous types. There are no wetland types in this biome; however, springs may support wetland type vegetation, such as Cattail (*Typha latifolia*), sedges (*Carex spp.),* and rushes (*Juncus spp.*).

Plants in the Desert Biome have adapted to the harsh climatic conditions of intense heat with little shade and precipitation. Plants, such as cacti, have adapted to the biome by altering their physical structure and usually have special means of storing and conserving

water. Other plants have acclimated to arid environments by growing extremely long roots, allowing them to acquire moisture at or near the water table. Still other desert plants have adjusted their behavior so that they grow and reproduce during the seasons of greatest moisture and/or coolest temperatures and remain dormant during the harshest (i.e., hottest and driest) months.

In the U.S., the Holmgren Milk Vetch (*Astragalus homgreniorum*) is endangered, and Welsh's Milkweed (*Asclepias welshii*) is threatened.

Wildlife

Desert animals include small nocturnal carnivores, insects, arachnids, reptiles, and birds. Desert animals are even more susceptible to the extremes of the desert climate than are plants. In response to extremely high temperatures and large diurnal temperature variations, many desert animals have evolved behavioral and/or physiological mechanisms to cope with the heat and aridity of the desert. Desert animals may adjust their behavior by breeding in the desert during the relatively cool spring and then migrating to cooler habitat for the remainder of the year, or they may be active only at dusk and dawn and retreat to the shade or burrow underground during the heat of the day. Some animals are completely nocturnal for this same reason. Some animals estivate (the opposite of hibernate), sleeping during the hottest and driest summer months. To increase their water intake, many desert animals rely on succulent plants, such as cacti, that store water in their tissue

The bald eagle could occur as a transient species in Desert biomes and it may fly over desert sites. Baird's sparrow and McCown's longspur are attracted to playas and grasslands that are also common in Desert biomes. Peregrine falcons have been reported from Lake Holloman, and potential feeding and nesting areas occur in other areas of the desert. These raptors may fly over the site.

The Desert Tortoise (*Gopherus agassizii*) and Chiricahua Leopard Frog (*Rana chiricahuensis*) are threatened under the Endangered Species Act in the U.S., and the Alamosa Springsnail (*Tryonia alamosae*) is endangered. (U.S. Army Space and Strategic Defense Command, 1997) The White Sands pupfish (*Cyprinodon tularosa)*, which is the only fish known to occur naturally on WSMR, is listed as endangered by the State of New Mexico and is endemic to Salt Creek, Malpais, and Mound Springs drainage basins.

Environmentally Sensitive Habitat

The USFWS designated habitat critical to the survival and recovery of the Mojave Desert populations of the Desert Tortoise in 1994. Critical Habitat Units in the map in Exhibit H-10 below were designated in California, Nevada, Utah, and in Arizona north and west of the Grand Canyon. This area includes Joshua Tree National Park.

Exhibit H-10. Critical Desert Tortoise Habitat

Source: California Turtle and Tortoise Club, 2003

Sensitive wildlife habitats occurring within the Desert Biome include White Sands pupfish habitat, raptor nesting areas, wetlands and riparian habitats, and other regionally valuable habitats such as grama grasslands and pinyon-juniper woodland, which are located within or adjacent to WSMR. Only 0.4 percent of WSMR has been mapped as jurisdictional wetlands, which are dispersed throughout the range. Limited water resources render most aquatic habitats critical as habitat for wildlife including the pupfish, particularly Salt Creek and its tributaries, Malpais and Mound Springs, Lost River, and Malone Draw. The San Andres National Wildlife Refuge, an area that provides habitat for a variety of sensitive species, was established in 1941 by EO 8646 for the conservation and development of natural wildlife resources. The refuge supports a population of state-endangered desert bighorn sheep (*Ovis canadensis*), as well as mule deer (*Odocoileus hemionus*), mountain lions (*Puma concolor*), golden eagles (*Aquila chrysaetos*), and gray vireos. Any activities related to the proposed BMDS with the potential to impact protected wildlife within the refuge are subject to review by the USFWS Refuge Manager. (U.S. Army Space and Missile Defense Command, 2002d)

H.6.4 Geology and Soils

Geology

Sand covers only about 20 percent of the Earth's deserts, with most of the sand in sand sheets and sand seas, vast regions of undulating dunes resembling ocean waves. Nearly 50 percent of desert surfaces are plains where the removal of fine-grained material by wind has exposed loose gravels consisting predominantly of pebbles and occasional cobbles, forming "desert pavement." Deflation basins, called "blowouts," are hollows

formed by the removal of particles by wind. Blowouts are generally small, but may be up to several kilometers in diameter.

The remaining surfaces of the Desert Biome are composed of exposed bedrock outcrops, desert soils, and fluvial deposits, including alluvial fans (a cone-shaped deposit of sediments), playas (dry lake beds), desert lakes, and oases. Bedrock outcrops commonly occur as small mountains surrounded by extensive erosional plains. Wind-driven grains abrade landforms, creating grooves or small depressions in rock. Sculpted landforms have been streamlined by desert winds and can be up to tens of meters high and kilometers long.

Soils

The desert soil is mostly sandy and is similar to the arid grassland soil described in the Section H.5.4. Desert soils are predominately mineral soils with low organic content. The repeated accumulation and subsequent evaporation of water in some soils causes distinct salt layers to form. Thus, poorly drained areas may develop saline soils and dry lakebeds may be covered with salt deposits. Desert soils tend to be low in humus and high in calcium carbonate. Calcium carbonate may cement sand and gravel into hard layers called “calcrete” that form layers up to 50 meters (164 feet) thick.

Biological soil crusts are often commonly found in arid environments, such as the Desert Biome, where vegetative cover is sparse. These crusts are formed by living organisms and their by-products, creating a crust of soil particles bound together by organic materials. Aboveground crust thickness can reach up to ten centimeters (four inches); however, crusts usually are concentrated in the top one to four millimeters (.04 to .16 inches) of soil. Due to their presence near the top surface layers of the soil, crusts primarily affect processes that occur at the land surface or soil-air interface, including soil stability and erosion, atmospheric N_2 fixation, nutrient contributions to plants, soil-plant-water relations, infiltration (of water), seedling germination, and plant growth.

Geological Hazards

Exhibits 3-5, 3-6, and H-7 show the geographic distribution for earthquakes, landslides, and volcanoes in the continental U.S. These geological hazards are concentrated in the western U.S., including areas where deserts lie.

H.6.5 Hazardous Materials and Hazardous Waste

Hazardous Materials

WSMR and Holloman AFB are existing sites where activities for the proposed BMDS may occur. The types of hazardous materials and hazardous waste produced at WSMR and Holloman AFB are representative of those that may be generated at other such sites within the Desert Biome, and they display appropriate management techniques.

A variety of hazardous materials are utilized and stored at WSMR to provide range-infrastructure support activities and at Holloman AFB to support mission activities. These include cleaning solvents, paints, motor fuels, and other petroleum products. These materials are issued through the facility supply system to individual users. The majority of these materials are consumed in operational processes, and the remaining materials are collected as hazardous waste. Specific types and quantities of materials can vary depending upon specific system and test-configuration requirements. Each agency utilizing WSMR is responsible for procurement and management of its hazardous materials. All use of hazardous materials by WSMR users requires approval and coordination with WSMR safety and environmental organizations. (U.S. Department of the Air Force, 1997b)

Hazardous Waste

When a hazardous material is spilled, spent, or contaminated to the extent that it is not able to be used for its original purpose, or cannot be converted to a usable product, it becomes a hazardous waste. Hazardous wastes can be generated on a continual basis or generated if a spill of a hazardous material occurs. Users of hazardous materials are responsible for the proper collection and disposal of hazardous waste generated as a result of their activity. This includes both waste generated during preflight activities at WSMR facilities, and waste generated following test operations. WSMR Regulation 200-1, *Environmental Hazardous Waste Management,* provides guidelines for handling and management of hazardous waste, and ensures compliance with Federal, state, and local laws regulating the generation, handling, treatment, storage, and disposal of hazardous waste. Under this regulation, hazardous waste generated during activities at WSMR is initially collected at the point of generation. Waste is containerized and segregated by waste type. From the initial collection point, all hazardous waste is collected and brought to a central collection facility for off-site shipment and disposal. Each range user is responsible for the cost of disposal of hazardous waste from its activities.

Holloman AFB maintains a Hazardous Materials Management Plan; a Hazardous Waste Management Plan to ensure compliance with applicable Federal, state, and local regulations; and Air Force directives related to hazardous materials and hazardous waste management. Holloman AFB also maintains a Spill Prevention and Response Plan in accordance with AFI 32-4002, *Hazardous Materials Emergency Planning and Response Program*. The Plan complies with EPA SPCC requirements; Emergency Planning and Community Right-to-Know Act; and Occupational Safety and Health Act requirements. The Plan provides guidance for the identification of possible hazardous material sources, the discovery and reporting of a hazardous materials release, and procedures to follow in the event a release occurs.

H.6.6 Health and Safety

Health and Safety attributes of the Desert Biome are similar to those discussed in Section H.1.6.

H.6.7 Noise

Ambient noise levels for remote desert environments range from 22 to 38 dBA, whereas, ambient noise levels at a representative sites where activities for the proposed BMDS may occur within the Desert Biome range from 65 to 85 dBA at Edwards AFB and from 45 dBA to 65 dBA at WSMR. (DOT, 2001) Noise sources associated with the proposed BMDS are described in Section H.1.7.

H.6.8 Transportation

In the Desert Biome of the western U.S., transportation is one of the primary environmental concerns with regard to air quality, water quality, habitat protection, land use, hazardous waste transportation, and noise pollution. Because the population density is so low and dispersed throughout most of the region, transportation infrastructure is concentrated near metropolitan centers, such as Phoenix, Arizona, and Los Angeles, California. Metropolitan areas are characterized by urban transit, a complex mix of heavy, light, and commuter rail; buses and demand responsive vehicles; ferries; and other less prevalent types such as inclined planes, trolley buses, and automated guide ways.

Ground Transportation

An extensive network of interstate highways and by-ways, spanning the vast distances between city centers transverse the western U.S. Desert Biome. The railroad system is also well developed throughout this region.

The road system at WSMR is described as representative of other installations located in the Desert Biome. WSMR's road network is extensive, but in relatively poor condition. There are three classifications of the road types on WSMR: major roads, secondary roads,

and trails. The major roads are two lane roads that are paved, graded, and maintained as funding permits. All the major roads on WSMR have the capacity to support 1,200 cars per hour for each lane. Approximately 966 kilometers (600 miles) of secondary roads serve the WSMR network. Secondary roads on WSMR are unpaved roads that are graded and maintained as funding permits. The WSMR road network has approximately 2,414 kilometers (1,500 miles) of bladed trails. These unpaved trails are bladed but not maintained on a regular basis. (U.S. Army Space and Missile Defense Command, 2002d)

A network of Federal and state highways serves WSMR and the immediate area. The Federal or U.S. highway system in the area is a network of six major routes that serve most of WSMR and the immediate area. The state highway system in the area provides access to local markets and urban areas. (U.S. Army WSMR, 1998)

Air Transportation

The major commercial airports serving the U.S. Desert region are Los Angeles International Airport, McCarran International Airport (Las Vegas, Nevada), Phoenix Sky Harbor International Airport, and Albuquerque International Airport all of which move millions of passengers each year.

Marine Transportation

There are no major U.S. ports associated with the Desert Biome because it does not extend to any coastal areas. There may be some ports associated with the international portions of this biome (e.g., Ensenada Port, Mexico).

H.6.9 Water Resources

Surface Water and Ground Water Resources

In the Desert Biome, droughts and aquifer supply issues are of particular concern. Increasing population pressures and need for irrigation water are quickly draining the limited underground reserves of water for the western U.S., making adequate water resources a contentious topic of scholarly and political debate.

For example, at WSMR, water supply sources are a critical concern in many areas. Freshwater aquifers are in a state of overdraft resulting in declining water tables and degraded water quality. The volume of ground water pumped in the Main Post area decreased from approximately 3.5 million cubic meters (925 million gallons) in 1967 to 3.3 million cubic meters (872 million gallons) in 1992. Water use in other areas varies from year to year according to missions in operation. (U.S. Army Space and Missile Defense Command, 2002d)

Water Quality

The leading causes of impairment of rivers and streams include pathogens (bacteria), siltation (sedimentation), and habitat alterations, and the leading sources for these include agriculture, hydraulic modifications, and habitat modifications. The leading causes of impairment of lakes, ponds, and reservoirs include nutrients, metals (primarily mercury), and siltation (sedimentation), and the leading sources for these are agriculture, hydraulic modifications, and urban runoff/storm sewers. The leading causes of impairment of estuaries include metals (primarily mercury), pesticides, and oxygen-depleting substances, and the leading sources for these include municipal point sources, urban runoff/storm sewers, and industrial discharges. (EPA, 2002)

The water quality of the freshwater aquifers at both WSMR and Fort Bliss is very good. Total dissolved solids at WSMR range from 200 to 420 milligrams per liter (parts per million). Hueco Bolson aquifers have total dissolved solids of approximately 600 milligrams per liter (parts per million). However, the quality of many of the freshwater aquifers in this region is decreasing due to increasing salinity.

Because irrigation is commonly practiced in arid desert biomes, drainage water from irrigated fields is a water body of concern. In 1982, dying waterfowl and waterfowl with birth defects and reproductive failures were discovered by the USFWS at the Kesterson Reservoir, National Wildlife Refuge, California. The cause of the problem was high levels of selenium in the irrigation drain water discharged into the reservoir. Since then, there has been significant media and congressional interest concerning the potential for similar toxic impacts from irrigation drain water at other locations across the western U.S. (Department of the Interior, 2003)

H.7 Tropical Biome

The Tropical Biome encompasses areas within the Pacific and Atlantic Oceans. For the purposes of this Programmatic Environmental Impact Statement (PEIS), the coastal zone is defined as the Exclusive Economic Zone, which is 322 kilometers (200 miles) off shore. The coastal zone also stretches 1,000 meters (3,281 feet) inland of the coastal shoreline, tidal wetlands, coastal wetlands, and coastal estuaries. (CPC of Australia, 2003) Because many of the islands within the Pacific and Atlantic Oceans are relatively small, the entire island may be considered within this affected environment section.

The Pacific Tropical Biome would include islands found within the equatorial region. The Pacific contains approximately 25,000 islands, the majority of which are found south of the equator. (Wikipedia, 2003) Current Ranges within this biome where activities of the proposed BMDS may occur include PMRF, USAKA, Wake Island, and Midway.

The majority of islands in the Atlantic Tropical Biome are in the Caribbean between the Caribbean Sea and the North Atlantic Ocean.

H.7.1 Air Quality

Climate

The climate for the Tropical Biome is tropical marine to semi-tropical marine, characterized by relatively high annual rainfall and warm to hot, humid weather throughout the year. The months of December to February tend to be cool, windy and wet, while May through October tend to be warm and sunny. Steadily blowing trade winds allow for relatively constant temperatures of 21°C to 27°C (70°F to 81°F) throughout the year. For islands lying South of the equator in the Pacific, such as American Somoa, the driest months are June to September and the wettest months are December to March.

Pacific

The annual rainfall in the Pacific Tropical Biome is approximately 127 to 1,016 centimeters (50 to 400 inches). In the Pacific, tropical storms and typhoons are common between May and December but can occur in any month. Regional trade winds from the eastern portion of the Pacific push equatorial surface water in to a mound in the west-equatorial Pacific Ocean, which affects atmospheric conditions. The trade winds occasionally weaken, causing a reverse flow of warm surface waters to the east, which then mound against South America. The additional pressure of warm water in the east-equatorial Pacific Ocean inhibits and slows the upwelling of the more dense, cold, and nutrient-rich deep ocean water (DOT, 2001b) in a phenomenon known as the El Nino/Southern Oscillation. The El Nino effect includes an extreme decline in ecological productivity along the coast of South America, and great fluctuations in heat transfer and molecular exchange between the ocean and the atmosphere throughout the Pacific region. (DOT, 2001b)

Atlantic

The Atlantic Tropical Biome typically experiences hurricanes that form close to the coast of West Africa and move westwards to the Caribbean. The hurricane season falls between June and November. However, most hurricanes tend to form during the month of September. The number of hurricanes varies annually from as few as two to as many as twelve. Hurricane weather is variable ranging from very low to heavy rainfall. Hurricane wind speeds tend to be severe, often traveling at more than 100 kilometers per hour (62 miles per hour). Hurricane tracks typically move across the Caribbean towards the southeastern U.S. and Mexico. (Caribbean, 2003)

Regional Air Quality

Pacific

Ambient air quality monitoring data is not readily available for islands in the Pacific. There is a sampling station on the island of Kauai, which monitors for PM_{10}. The area around the sampling station is classified as being in attainment for both National and State Ambient Air Quality Standards. However, the sampling station is located in the city of Lihue, which is located 42 kilometers (26 miles) from PMRF and is on the southeast side of the island; thus, air quality measurements there may not be representative of air quality at PMRF. Strong winds in the tropical Pacific region tend to disperse local emissions. Therefore there are no major air pollution problems.

Atlantic

In the Caribbean, increasing urbanization and rampant forest destruction have led to considerable air quality degradation. Rapid urbanization, population growth, industrialization, and a growing number of motor vehicles are the main causes of air pollution. The growth of industry, agriculture, and the transportation sector over the past 30 years has been accompanied by a steady increase in CO_2 emissions. Industrial pollutants originate mostly from fuel combustion processes in the power generation sector, although emissions of heavy metals, such as lead and mercury, also are important. Air quality at the local and regional level is affected by other sources of air pollution, such as pesticide use in agriculture and airborne particles resulting from soil erosion and biomass combustion.

Existing Emission Sources

Pacific

Primary pollution sources in the Pacific Tropical Biome include power plants, diesel-fuel powered generators, fuel storage tanks, solid waste incinerators, aircraft operations, and vehicles. Existing rocket launches in the area are typical of smaller sources of emissions. The primary toxic air contaminant emitted from solid rocket launches is hydrochloric acid. The Clean Air Act Amendments allow regulation of rocket engine test firing by the manufacturer and do not regulate the launch by an operational user.

Because of the relatively small numbers and types of air pollution sources, dispersion caused by trade winds, and lack of topographic features at most locations, air quality in the equatorial region is considered good (i.e., well below the maximum pollution levels established for air quality in the U.S.). (U.S. Army Space and Missile Defense Command, 2003)

Atlantic

The main contributors to poor air quality in the Atlantic Tropical Biome include inadequate vehicle emissions controls, exacerbated by recent influxes of foreign used vehicles with inadequate emission devices; industrial activity; inefficient energy use; high-density settlements and urban areas; pesticide residues from spraying in rural agricultural communities; and particulates from soil erosion and sugar cane burning.

Regulations and infrastructure for ambient air quality monitoring in the Caribbean are limited. Counties with dependence on the U.S. have well-established ambient air monitoring programs for PM, SO_2, and CO. Routine monitoring in other islands is limited to stations near industrial sources.

H.7.2 Airspace

Controlled and Uncontrolled Airspace

Pacific

The majority of islands in the Pacific Tropical Biome are located in international airspace and therefore, the procedures of the ICAO are followed. ICAO Document 4444 is the equivalent air traffic control manual to the FAA Handbook 7110.65, *Air Traffic Control*. The ICAO is not an active air traffic control agency and has no authority to allow aircraft into a particular sovereign nation's Flight Information Region or Air Defense Identification Zone and does not set international boundaries for air traffic control purposes. The ICAO is a specialized agency of the United Nations whose objective is to develop the principles and techniques of international air navigation and to foster planning and development of international civil air transport. The FAA acts as the U.S. agent for aeronautical information to the ICAO. Airspace in this region would be managed by the Honolulu and Oakland ARTCCs.

Atlantic

The Atlantic Tropical Biome consists of both U.S. and international airspace. U.S. territorial possessions in the Caribbean are defined as Puerto Rico, which includes Puerto Rico, Vieques, Culebra, Caja de Muertos, Desecheo Island, and Mona Island, and the U.S. Virgin Islands, which include Saint Croix, Saint John, and Saint Thomas. On November 28, 2001, the FAA authorized aircraft registered in the U.S., Canada, Mexico, the Bahamas, Bermuda, Cayman Islands, and British Virgin Islands to operate VFR/IFR in the sovereign airspace of the U.S. and its territorial possessions. International airspace in the Caribbean is subject to the operating rules of the ICAO. The airspace of all states and territories of the Eastern Caribbean Islands including adjacent international waters comprise the Piarco Flight Information Region.

Special Use Airspace

Pacific

The procedures for scheduling each portion of airspace are performed in accordance with letters of agreement with the controlling FAA facility. Schedules are provided to the FAA facility as agreed between the agencies involved. The special use airspace at the PMRF consists of Restricted Areas R-3101, which lies immediately above PMRF/Main Base and to the west of Kauai, and R-3107, which lies over Kaula, a small uninhabited rocky islet 35 kilometers (19 nautical miles) southwest of Niihau. The special use airspace also includes Warning Area W-188 north of Kauai, and Warning Area W-186 southwest of Kauai, all controlled by PMRF. Warning Areas W-189 and W-190 north of Oahu and W-187 surrounding Kaula are scheduled through the Fleet Area Control and Surveillance Facility. Exhibit H-11 lists the affected Restricted Areas and Warning Areas and their effective altitudes and times used. The controlling agency for the Restricted Areas and Warning Areas is the Honolulu Combined Center Radar Approach Center.

Exhibit H-11. Special Use Airspace in the PMRF/Main Base Airspace Use Region of Influence

Number	Location	Altitude	Time of Use	
			Day	Hours
R-3101	PMRFAC FOUR	To Unlimited	Monday - Friday	0600-1800
R-3107	Kaula	To FL 180 (5,500 meters [18,000 feet] above MSL)	Monday - Friday	0700-2200
W-186	Hawaii	To 9,000	Continuous	Continuous
W-187	Hawaii	To 18,000	Monday - Friday Saturday - Sunday	0700-2200 0800-1600
W-188	Hawaii	To Unlimited	Continuous	Continuous
W-189	Hawaii	To Unlimited	Monday - Friday Saturday - Sunday	0700-2200 0800-1600
W-190	Hawaii	To Unlimited	Monday - Friday Saturday - Sunday	0700-2200 0800-1600

Source: U.S. Department of the Navy, 1998

Airports/Airfields

Pacific

There are numerous Range-affiliated airports and airfields located within the Pacific Tropical Biome, including Wake Island, USAKA, PMRF, and Midway. Many of these airfields are engaged in activities similar to those of the proposed activities. Future test events would act in accordance with existing activities at the airfields.

Atlantic

The majority of local airports within the Atlantic Tropical Biome handle smaller, private aircraft, which are uncontrolled.

En Route Airways and Jet Routes

Pacific

High-altitude overseas jet routes cross the Pacific Tropical Biome via nine Control Area Extension corridors off the California coast. These corridors and associated jet routes continue northwest to Alaska and then southwest to the Orient. These corridors can be opened or closed at the request of a user in coordination with the FAA. A Memorandum of Agreement exists between users and the FAA to stipulate the conditions under which the Control Area Extensions can be closed to civil traffic. Under most circumstances, at least one Control Area Extension must remain available for use by general aviation and commercial air carriers.

H.7.3 Biological Resources

Vegetation

Pacific

Many plant species have been introduced to the islands in the Pacific Tropical Biome since the arrival of permanent residents. The most common of these include ironwood, golden crown-beard (*Verbesina encelioides*), wild poinsettia (*Euphorbia heterophylla*), Haole koa (*Leucaena leucocephala*), sweet alyssum (*Lobularia maritima*), buffalo grass (*Buchloe dactuloides*), peppergrass (*Lepidium lasiocarpum*), and Bermuda grass (*Cynodon dactylon*). Some examples of indigenous vegetation on the islands include beach naupaka (*sericea Vahl*), tree heliotrope (*Tournefortia argentea*), beach morning glory (*Ipomoea imperati*), lovegrass, sickle grass (*Pholiurus incurvus*), ihi (*Portulaca molokiniensis*), alena (*Boerhavia repens*), puncture vine (nohu) (*Tribulus citadoides*), and ‘ena’ena (*Pseudognaphalium* [=*Gnaphalium*] *sandwicensium var. molokaiense*). Some

islands also include ruderal vegetation, which is vegetation that grows where the natural vegetational cover is disturbed by human activities in addition to the naturally occurring kiawe (*Prosopis pallida*)/koa haole (*Leucaena leucocephala*) scrub.

Atlantic

The Atlantic Tropical Biome habitat includes seagrass meadows, which occur in the protected waters landward of coral reefs. The two main seagrass species, the turtle grass (*Thalassia testudinum*) and the manatee grass (*Syringodium filiforme*), occur either in mixed or in monospecific beds. Mangroves are found along the coasts of tropical and subtropical regions. The term mangrove refers to both the forest and the tree. Mangroves protect coasts against erosion by breaking storm waves and dampening tidal currents.

Wildlife

Pacific

The Laysan albatross (*Diomedea immutabilis*), a migratory bird protected under the Migratory Bird Treaty Act, uses ruderal vegetation areas in some islands in the Pacific Tropical biome for courtship and nesting. The Laysan albatross is being discouraged from nesting at existing Ranges to prevent interaction between the species and aircraft using the runway. This action is being accomplished under USFWS permits. Other species of birds found in this region include red-tailed tropicbirds (*Phaethon rubricauda*), black noddies (*Anous minutus*), Pacific golden plover (*Pluvialis fulva*), ruddy turnstone (*Arenaria interpres*), white terns (*Chlidonias leucopterus*), short-tailedand black-footed albatross (*Phoebastria nigripes*), shearwaters, brown (*Sula leucogaster*), masked (*Sula dactylatra*), and red-footed booby (*Sula sula rubripes*).

There are five species of giant clams found in areas of the Western Pacific Tropical Biome. The largest species (*Tridacna gigas*) was observed during a 1998 inventory (Army, 2001). The species has been significantly reduced in numbers. All species of mollusks in the family *Tridacnidae* are listed as protected under the Convention for the International Trade on Endangered Species (USFWS, 2002).

Atlantic

Grazers, such as green sea turtles (*Chelonia mydas*), fish, and sea urchins feed directly on seagrasses. Seagrass beds also serve as nursery grounds for the juveniles of many commercially important species, such as snappers, grunts, lobsters and conchs. Mangroves serve as nursery grounds for the juveniles of many commercially important fisheries species and provide habitat for a variety of small fish, crabs, and birds. Sea turtles use many beaches in the Caribbean to dig their nests and deposit their eggs. The

beach also provides habitat for burrowing species, such as crabs, clams, and other invertebrates.

Hawaiian monk seals (*Monachus schauinslandi*) are found throughout the region. Eastern and Spit islands are the main pupping areas. The monk seal is endemic to the Hawaiian archipelago and is found almost exclusively in the Northwestern Hawaiian Islands.

The Hawaiian (American) coot (*Fulica americana alai*), Hawaiian black-necked stilt (*Himantopus mexicanus knudseni*), Hawaiian common moorhen (*Gallinula chloropus sandvicensis*), and Hawaiian duck (*Anas wyvilliana*) are Federal and State endangered species that have been observed in the drainage ditches and ponds on PMRF/Main Base.

The Hawaiian Gallinule *(Gallinula chloropus sandvicensis)* is a Federally listed endangered subspecies of the common North American moorhen. Newell's shearwater (*Puffinus auricularis newelli*) and the dark-rumped petrel (*Pterodrome phaeopygia sandwicense*) are listed as federally endangered species. The Hawaiian duck (*Anas wyvilliana)* is a federally listed endangered species of duck, which has been observed in the wetlands of PMRF and the ditches of Mana.

The Green sea turtle (*Chelonia mydas*) is a federally threatened sea turtle found in the eastern North Pacific from Baja California to southern Alaska. The sea turtles are sighted year round in eastern portions of the Pacific Ocean, generally in waters less than 50 meters (164 feet) deep. Populations appear to be highest from July to September. Threats to the green sea turtle include over harvesting by humans, habitat loss, fishing net entanglement, boat collisions, and disease. (Sacramento Fish and Wildlife Office, 2003)

The Loggerhead sea turtle (*Caretta caretta*) is a federally threatened sea turtle similar to the green sea turtle. It has been observed at depths up to 1,000 meters (3,280 feet). Threats to loggerhead sea turtles include exploitation, loss of habitat, fishing practices, and pollution.

The Leatherback sea turtle (*Dermochelys coriacea*) is a federally listed endangered species. The Leatherback is a highly migratory species and is more pelagic than other sea turtles, meaning they tend to stay in the open ocean rather than in areas closer to the coast. They are sighted most often during July to September. Threats to the sea turtles include exploitation, loss of habitat, fishing practices, and pollution.

The Olive ridley sea turtle (*Lepidochelys oliveacea*) is a federally listed threatened species. (NOAA, 2003b) The Olive ridley is primarily tropical nesting from southern Sonora, Mexico to Colombia. Individuals are seen rarely in the waters off the southwestern U.S. They have been observed in the eastern Pacific Ocean in waters less than 50 meters (164 feet), but are rarely encountered.

Marine mammals that may reside in the ocean area and that are listed under the Endangered Species Act include several species of cetaceans (i.e., the blue whale [*Balaenoptera musculus*], finback whale [*Balaenoptera physalus*], humpback whale [*Megaptera noveangliae*], and sperm whale [*Physter catodon*]). These are open-water, widely distributed species.

Non-native species, such as feral dogs (*Canis familiaris*) and cats (*Felis catus*) occur in the region and prey on native and introduced species of birds. Rodents including the Polynesian black rat (*Rattus exulans*), Norway or brown rat (*Rattus norwegicus*), and the house mouse (*Mus musculus domesticus*) also are known to inhabit the region. (U.S. Army Space and Strategic Defense Command, 1993a)

Environmentally Sensitive Habitat

Pacific

A submerged barrier reef that is roughly 13 kilometers (eight miles) long and composed of fossil coral (*Porites compressa*) lies offshore of the island of Kauai. The reef has an irregular appearance resulting from numerous ledges, walls, slumped limestone blocks, and mounds. Coral and fish diversity is low within the exercise area as a result of deep water, low coral density, and seasonal sand scouring. Fishes associated with the low vertical relief habitat include the bluestripe snapper (*Lutjanus kasmira*) and several species of burrowing blennies. Pelagic (open ocean) fishes associated with the exercise area include jacks, amberjack (*Seriola dumerili*), and flying fishes.

The Hawaiian Islands Humpback Whale National Marine Sanctuary was designated by Congress in 1992. Humpback whales (*Megaptera novaeangliae*) are endangered marine mammals and are therefore protected under provisions of the Endangered Species Act and the Marine Mammal Protection Act wherever they are found. Humpbacks are present in the winter months in the shallow waters surrounding the Hawaiian Islands, where they congregate to mate and calve. By agreement with the Governor of the State of Hawaii in 1997, NOAA's Sanctuaries and Reserves Division modified the Congressionally defined boundary of the Hawaiian Islands Humpback Whale National Marine Sanctuary so that it includes certain portions of the shallow water along northern Kauai. Regulations implementing designation of the sanctuary specifically recognize that all existing military activities outlined or external to the sanctuary are authorized, as are new military activities following consultation with the NOAA Fisheries Service. (62 FR 14816, 15 CFR §922.183)

All of Midway Atoll, except for Sand Island and its harbor, has been designated as critical habitat for the Hawaiian monk seal. A small (less than 0.2 hectares [0.5 acres]), emergent wetland area has been identified on Sand Island. It is located west of Decatur

Avenue, north of the cemetery, and south of Halsey Drive. (U.S. Department of the Navy, 1998)

The Coral Reef Ecosystem Fishery Management Plan for the western Pacific has established Marine Protected Areas. No-take Marine Protected Areas are at 0 to 10 fathom (0 to 18 meter [0 to 60 foot]) depths. No-take Marine Protected Areas also are located from ten to 50 fathoms (18 to 91 meters [59 to 299 feet]) at French Frigate Shoals, Laysan, and the northern half of Midway. The southern half of Midway is for recreational catch and release only. (Western Pacific Fisheries Management Council, 2003)

H.7.4 Geology and Soils

Geology

Pacific

Geomorphically, islands within the Pacific Tropical Biome are exceedingly varied and therefore difficult to generalize. The islands range from atolls with small, low inlets and extensive lagoons, to raised limestone islands, to volcanic high islands with substantial topographic and internal climatic diversity. About half of the Caroline Islands and 80 percent of the Marshall Islands are atolls, some of which peak at only a few feet above present sea level. Volcanic islands, on the other hand, can reach heights of more than 3,962 meters (13,000 feet), as does the snow-capped peak of Mauna Kea on the island of Hawaii. (East-West Center, 2001)

Coral reefs have developed upon the eroded platforms around some of the islands. Wave action has eroded the coral surface in many areas, creating a primary source for beach sand, which is actively being deposited and reworked along the shorelines of some islands. Some of the reefs and islands consist entirely of the remains of coral reef rock and sediments to a thickness of several thousand feet atop submarine volcanoes, which formed 70 to 80 million years ago. As the volcanoes became extinct and began to subside, living coral reefs grew and formed atolls. The reef rock is formed entirely from the remains of marine organisms that secrete external skeletons of calcium and magnesium carbonates. (East-West Center, 2001)

High volcanic islands, which tend to have larger surface areas, generally have more fresh water, better soils, and more diverse resource bases. Low-lying atolls, on the other hand, are prone to drought and erosion, and generally (at least on land) have limited natural resources. (East-West Center, 2001)

Windward oceanic reef flats generally are composed of hard rock that extends downward for 0.6 to 1.2 meters (two to four feet), with softer or unconsolidated rock below that

level. (U.S. Army Space and Strategic Defense Command, 1993a) Lagoon reef flats are typically narrower than the ocean reef flats and are composed of softer rock.

Atlantic

Islands within the Atlantic Tropical Biome are composed of two distinctive chains of islands, the Lesser and Greater Antilles. The Lesser Antilles are a line of mainly volcanic islands sweeping northward from the island of Trinidad, while the Greater Antilles consist of four large islands that are part of a submerged mountain range jutting westward into the Caribbean for over a thousand miles. The islands are characterized by a range of geological formations, from volcanic and sedimentary strata to coral limestone and alluvium. The majority of the islands lack rivers or streams due to the porous nature of mountainous rock and the absence of hills or valleys. The lack of water and sediment runoff into the sea contributes to the clarity of surrounding waters. Numerous cracks and fissures may be found within the rock formations.

Soils

Pacific

The soils on smaller atolls in the Pacific Tropical Biome have poor fertility and are deficient in N_2, potash, and phosphorus. This low fertility is due to alkalinity, which inhibits the absorption of iron, manganese, zinc, boron, and aluminum; and course soil particles and low organic matter content, which both impair the soils water-holding capacity. All of these factors severely inhibit plant growth. Poor soil fertility on some islands also is due to human activities (e.g., forest cutting, slash and burn, copra plantations, war). High volcanic islands tend to have larger surface areas, and have better soils. In many places, the surface layers are dark brown as a result of accumulated organic matter and alluvium. The silt is neutral to moderately alkaline through its profile. The soils are permeable, and infiltration is rapid. Wind erosion is severe when vegetation has been removed.

Atlantic

The islands within the Atlantic Tropical Biome include a wide range of soils, which may be derived from limestone, serpentine, dolomite, basalt, granite, diorite, gabbro, sandstone, or slate. The humid tropical environment and mountainous terrain of many islands are conducive to high rates of sedimentation. Washed from the hill slopes and construction sites, sediments settle out in the calm waters of the reservoirs, thus reducing the storage capacity of the reservoirs. Major floods associated with hurricanes and tropical disturbances may cause extensive land erosion and sediment transport that rapidly deplete the storage capacity of reservoirs.

Geological Hazards

Pacific

Volcanic islands within the Pacific Tropical Biome have been built of successive lava flows. Volcano eruptions occur relatively frequently on the islands. Eruptions typically start with lava issuing vertically from a central vent or fissure in a rhythmic jet-like eruption, called a lava fountain. (NOAA, 2003b)

Atlantic

Many earthquakes and tsunamis have occurred in the northeastern Caribbean, where the movements of the Earth's surface plates are rapid and complicated. The Caribbean is one of the smaller surface plates of the Earth. The approximately rectangular plate extends from Central America on the west to the Lesser Antilles on the east, and from just south of Cuba on the north to South America on the south. Earthquakes occur all around its periphery. Tsunami waves form when large pieces of the sea floor undergo abrupt vertical movement due to fault rupture, landslides, or volcanism. (USGS, 2001)

Volcanoes erupt on the eastern and western sides of the Caribbean plate. There are active volcanoes in the southern Caribbean islands, most recently on the island of Montserrat. Current eruptions of the Soufriere Hills Volcano, which is located at the south end of Montserrat Island in the Lesser Antilles, began on July 18, 1995. The summit area consists primarily of a series of east/southeast-trending lava domes. The volcano is 915 meters (3,010 feet) high and monitored by the Montserrat Volcano Observatory. (USGS, 2002a)

H.7.5 Hazardous Materials and Hazardous Waste

Hazardous Materials

Pacific

Test event sponsors would be responsible for safe storage and handling of the materials that they obtain and must adhere to all DOT hazardous materials transportation regulations. Hazardous materials used in support of test event activities would include propellants, various cleaning solvents, paints, cleaning fluids, fuels, coolants, and other materials. Releases of materials in excess of reportable quantities specified by CERCLA would be reported to the EPA. Material and Safety Data Sheets would be available at the use and storage locations of each material.

The use of hazardous materials at the ranges is limited primarily to materials used in facility infrastructure support and flight operations, with some additional quantities of

hazardous materials used by various test operations at the range. The use of these materials must conform to Federal, DoD, and Army hazardous materials management requirements. Hazardous materials used in base infrastructure support activities include various cleaning solvents, paints, cleaning fluids, pesticides, motor fuels and other petroleum products, freons, and other materials. Aircraft and helicopter flights use various grade of jet propellant, which are refined petroleum products.

All shipping would be conducted in accordance with DOT-approved procedures and routing, as well as OSHA requirements, U.S. Army safety regulations, and USAF regulations. Appropriate safety measures would be followed during transportation of the propellants as required by the DOT and as described in 49 CFR 171-180, *Hazardous Materials Regulations of the Department of Transportation*.

For ship or barge transportation, U.S. Coast Guard and/or applicable U.S. Army transportation safety regulations also would be followed. Appropriate safety measures would be followed during loading of missiles and propellants as required by DoD and as described in DoD 6055.9-STD, *DoD Ammunition and Explosives Safety Standards.*

Atlantic

The transport of potentially hazardous substances, such as oil, fertilizers and insecticides is always a hazardous activity, and there have been several oil spills within the Caribbean region. While the local impact is immediate and obvious, there is little information and few quantified studies on the long-term effects of oil in the coastal zone. Corals do not die from oil remaining on the surface of the water. However, gas exchange between the water and the atmosphere is decreased, with the possible result of oxygen depletion in enclosed bays where surface wave action is minimal. Coral death does result from smothering when submerged oil directly adheres to coral surfaces, and oil slicks affect sea birds and other marine animals. Tar accumulation on beaches reduces tourism potential of coastal areas. With increased shipping activity in the Caribbean, the dumping of garbage and washing of bilges at sea have become serious problems. Garbage dumped in international waters are driven by wind and currents to the shorelines of the Caribbean, causing persistent pollution, which threatens both the tourism and fishing industries, as well as the health of coastal communities.

Hazardous Waste

Pacific

Test event sponsors would be responsible for tracking hazardous waste; for proper hazardous waste identification, storage, transportation, and disposal; and for implementing strategies to reduce the volume and toxicity of the hazardous waste generated.

Federal Ranges located within the Pacific Tropical Biome manage hazardous materials through the Navy's Consolidated Hazardous Materials Reutilization and Inventory Management Program. This program mandates procedures to control, track, and reduce the variety and quantities of hazardous materials use at facilities. Individual Ranges may have additional management and disposal procedures for used oils and fuels and management plans for pollution prevention, installation restoration, storage tanks, pesticides, radon, ordnance, polychlorinated biphenyls, medical and biohazard wastes, lead-based paints, and asbestos.

Atlantic

Hazardous waste generated within the Atlantic region of the Tropical Biome that require disposal is disposed of in accordance with Federal safety and environmental regulations.

H.7.6 Health and Safety

Health and Safety attributes of the Tropical Biome are similar to those discussed in Section H.1.6.

H.7.7 Noise

Natural background sound levels in the Tropical Biome are relatively high due to wind and surf.

Sources of noise in the Tropical Biome are similar to principle sources of noise associated with sites where activities for the proposed BMDS may occur, as described in the Section H.1.7.

H.7.8 Transportation

The Tropical Biome includes transportation that could be affected by the Proposed Action. The smaller islands may require marine transport vessels to transport passengers and supplies between islands.

The isolated locations of the equatorial environments make transportation vital to many of the locations. Many of the islands or atolls are chains of multiple islands that may require transportation of workers, visitors, and cargo between outside locations and the islands. Also, there are many islands that serve as refueling stops for military and nonmilitary flights in the Pacific Ocean. Small DeHaviland-7 aircraft or helicopters may be used for intra-island transportation.

Ground Transportation

Ground transportation facilities consist of roadways and pathways used by motor vehicles, bicycles, and pedestrians. For many of the islands, distances traveled are short, and people travel mostly on bicycle or on foot, or by using scheduled shuttle buses. Private automobiles are banned on some islands such as USAKA.

Air Transportation

Air transportation is an integral method used to transport goods to and from the island locations in this biome, due to the fact that are not linked to U.S. mainland ground transportation networks. Airports range in size from small airfields, supporting single engine planes, to larger international airports such as Luis Munoz Marin International Airport in Puerto Rico, which is the 37th most active passenger airport in the U.S.

Marine Transportation

Ships and smaller craft carry ocean cargo and fuel to the Equatorial Islands and deliver workers and cargo, including fuel, between islands. Many of the islands associated with this biome have major working ports, such as San Juan Harbor, Puerto Rico, which is in the top 17 ports of the world for container movement.

H.7.9 Water Resources

Surface Water and Ground Water Resources

Pacific

On some of the islands, seasonal infiltration of rainwater recharges the aquifer, and potable water is provided by rainwater catchments. Coral atolls typically lack surface water bodies or defined drainage channels due to extreme porosity and permeability of the soils. Rainwater typically drains rapidly into the ground.

Seasonal rainfall is the primary source of freshwater for most small atolls. Catchments are used to capture rainfall for potable use. Raw water is stored in aboveground storage tanks. On the Kwajalein atoll in particular, water is shipped from Kwajalein to the other islands that do not have catchments and to ships that visit.

Ground water on the smaller atolls typically occurs as a lens of fresh to brackish water floating on deeper marine waters in the subsurface rock strata of larger and wider islands. Seasonal infiltration of rainwater recharges the aquifer. The size and salinity of the lens are affected by many factors, including the distribution and composition of the rock, tidal

fluctuations, gravitational forces, salt spray, mineral dissolution, and the rate of ground water pumping.

Atlantic

Coastal areas of the Caribbean near major watersheds often contain large lagoons of fresh or brackish water. Estuaries, coastal lagoons, and other inshore marine waters are very fertile and productive ecosystems, because they serve as important sources of organic material and nutrients and provide feeding, nesting, and nursery areas for various birds and fish. These ecosystems act as sinks of terrestrial runoff, trapping sediments and toxins, which may damage the fragile coral reefs.

Salinas, or shallow ponds or lakes with limited water circulation and tidal contact, are found on many dry Caribbean islands. They function as sediment traps, protecting coral reefs from excessive sediment loading.

Water Quality

The coastal zone is the ultimate depository of most pollutants originating from land or sea. Of the land-based sources of pollution, eutrophication, or nutrient enrichment, from human sewage disposal is a growing problem in the Caribbean, particularly in the vicinity of large coastal cities and harbors. Increased nutrient loading from sewage stimulates algal growth and degrades coral reefs and seagrasses. Activities outside of the coastal zone also may have a direct impact on the health of the coastal areas, for example when sedimentation and pollution from forestry and agriculture enter coastal areas via rivers and other waterways. Agricultural pesticides and fertilizers result in changes in the reef and seagrass communities, and in high concentrations, may cause fish kills in areas of poor water circulation. Sedimentation from land clearance results in increased water turbidity, which in turn decreases the productivity of coral reefs and seagrasses. With high levels of sedimentation, physical smothering of corals and benthic organisms by sediments and fine silt may take place.

Pacific

The prevailing trade winds cause strong currents to enter the lagoon water in the Pacific Atolls. The currents are a major source of seawater exchanging with lagoon water, and they help to keep the lagoons in the Pacific relatively well mixed. Water quality in the near shore and lagoon waters is generally of very high quality, with high dissolved oxygen and pH at levels typical of mid-oceanic conditions.

Open sea waters are typically alkaline, and have a pH of greater than 8.0, which allows the buffering of acidic rocket emissions without significant long-term change to water chemistry. Water quality in the open ocean is described as having high water clarity, low

concentrations of suspended matter, dissolved oxygen concentrations at or near saturation, and low concentrations of contaminants such as trace metals and hydrocarbons.

Atlantic

Problems with freshwater ecosystems are a major environmental issue in the Caribbean. Water pollution, siltation of reservoirs, and excessive withdrawals of fresh water from rivers are problems associated with the growing human populations of the islands. (USGS, 1999)

H.8 Savanna Biome

The Savanna Biome includes the transitional zone between the tropical forest and the semi-desert scrub vegetation types and typically occupies latitudes between 5º and 20º North and South of the equator (see Exhibit 3-18, Volume 1). Savannas cover extensive areas in the tropics and subtropics of Central and South America, Central and South Africa, and northern Australia in both inland and coastal areas. The description in this section is representative of this biome throughout the world.

H.8.1 Air Quality

Climate

The climate of the Savanna Biome is typically semi-humid tropical, with a six- to eight-month hot, rainy summer season and a cooler, drier winter season.[13] A marked temperature and rainfall gradient is shown across the latitudinal range. Towards the equator, annual rainfall is typically higher relative to the more poleward edges of the Savanna belt, and total annual precipitation may be as high as 250 centimeters (98 inches). On the Savanna edges nearest the tropics (towards the poles), annual rainfall totals may be as little as 50 centimeters (20 inches). In Australian Savanna Biomes, coastal areas receive twice as much rainfall as inland savannas.

Annual temperatures in the Savanna Biome are relatively constant, averaging roughly 24ºC to 27ºC (75ºF to 80ºF). When the temperature fluctuates (ranging between 20ºC to 30ºC [68ºF to 86ºF]), it is a gradual change; the Savanna Biome does not experience drastic temperature swings. The average temperature during the wet summer season is 29ºC (85ºF) and can reach 49ºC (120ºF) in locations away from the moderating effects of the coastal waters. The temperature during the dry winter season averages around 21ºC (70ºF).

[13] Summer/winter references are in terms of Southern hemisphere concepts of seasons. The wet season would occur during the Northern hemisphere winter, and the dry season would be in the Northern hemisphere summer.

The wet season may experience periods of flooding due to the poorly drained soils, especially at the start of the season when the ground is particularly parched. The dry season is marked by months of drought and fire, which are essential to the maintenance of savannas and which require adaptive mechanisms for plants and animals to survive.

Regional Air Quality

The Savanna Biome faces similar air quality concerns as those found in the Grassland Biome, namely emissions from open burning, natural drought-driven fires, and other fugitive dust. Open burning frequently occurs in more rural areas to eliminate noxious weeds or crop-damaging pests in agricultural fields and to dispose of household waste. Because savannas may experience periods of drought during the dry season, fugitive dust may be kicked up and circulated in the atmosphere, enabling it to travel long distances due to the lack of natural barriers. Savanna fires represent the dominant source of carbon released to the atmosphere from global annual biomass burning, contributing one to 1.6 giga-tons of carbon. Additionally, large quantities of NO_X have been observed in plumes of savanna fires. (Committee on Earth Observation Satellites, 2000)

Dust can be blamed for the trans-regional transport of air toxics and other pollutants that "hitch a ride" on airborne dust particles. Therefore, pollution that arises in the Savanna Biome or nearby areas can degrade global air quality.

Existing Emission Sources

Due to the rural nature, and therefore low population density, of most Savanna Biomes, biogenic, or naturally occurring, activities are the predominant sources of air pollution emissions in this biome. Fire is a predominant emission source, while anthropogenic activities, such as agriculture and mining also contribute. Overgrazing of ranch lands increases fugitive dust emissions. Agriculture produces a variety of non-methane VOCs from livestock and crop sources that contribute to the production of secondary pollutants, such as ozone, which in turn damages crops and natural fauna. N_2 also is produced from aerobic vegetative processes, anaerobic soil activity, and through animal excretion. Ammonia emissions are likewise attributed to livestock wastes. It also has been established that ruminant animals (e.g., cows) exhale dimethyl sulfide, which oxidizes to sulfuric acid and contributes to the formation of acid rain.

H.8.2 Airspace

Controlled and Uncontrolled Airspace

The Savanna Biome is located in international airspace; and therefore, the procedures of the ICAO are followed. ICAO Document 4444 is the equivalent air traffic control manual to the FAA Handbook 7110.65, *Air Traffic Control*. The ICAO is not an active

air traffic control agency and has no authority to allow aircraft into a particular sovereign nation's Flight Information Region or Air Defense Identification Zone and does not set international boundaries for air traffic control purposes. The ICAO is a specialized agency of the United Nations whose objective is to develop the principles and techniques of international air navigation and to foster planning and development of international civil air transport. The FAA acts as the U.S. agent for aeronautical information to the ICAO.

Special Use Airspace

Warning Areas are established in international airspace to contain activity that may be hazardous and to alert pilots of nonparticipating aircraft to the potential danger.

Airports/Airfields

Civilian, military, and private airports exist in the Savanna Biome.

En Route Airways and Jet Routes

There are no domestic jet routes in the Savanna Biome. Site-specific analysis would be conducted to ensure that international and foreign government airspace requirements are met.

H.8.3 Biological Resources

Vegetation

Savannas are characterized by a continuous cover of perennial grasses, often one to two meters (three to six feet) tall at maturity. They also may have an open canopy of drought- or fire-resistant trees or an open shrub layer. The Savanna Biome is a transitional biome between those dominated by forest and those dominated by grasses. Most savanna grass is coarse and grows in tufts with intervening patches of bare ground. Trees may be scattered individually or grow in small intermittent groves. The presence of trees is limited by the low annual level of rainfall and intense sunlight, as well as seasonal fires that burn back forests and stimulate the growth of grasses, similar to those occurring in the Grasslands Biome.

The type of vegetation found in the Savanna Biome varies geographically based on soil and rainfall characteristics between the three continents where savannas are predominantly found – Central and South America, Central and South Africa, and northern Australia. Annual rainfall is higher in the Central and South America savannas and therefore, cypress (*Cupressus sempervirens*) and nance (*Byrsonima crassifolia*) trees thrive in this region. Fire tolerant tree species, such as Caranday palm (*Copernicia alba*)

and tusequi (*Machaerium hirtum*), exist in drier areas. Sedges and grasses, such as Mexican papyrus (*Cyperus giganteus*), annual spikerush (*Eleocharis geniculata*), and brook crowngrass (*Paspalum acuminatum*), among others, dominate the more flood-prone areas. Wetlands also may be found in these savannas due to seasonal flooding. Cactii may be present on termite mounds that commonly are found in the Savanna Biome.

In African savannas, acacia (*Acacia spp.*) and baobab trees (*Adansonia Digitata*) dominate the savanna overstory. Other hardy plants that constitute the grassy-shrub understory include the boscia (*Boscia angustifolia*) and sporobolu (*Sporobolus indicus*); Combretum (*Combretum molle*) and Terminalia (*Terminalia arjuna*) shrub and tree species; and tall grasses, such as elephant grass (*Pennisetum purpureum*), Sorghum (*Sorghum bicolor*), and Eriachne (*Eriachne spp.*).

Australian savannas are marked by eucalypt woodland with a grassy understory. Dominant tree species in the coastal lowland savannas are Darwin woolybutt (*Eucalyptus miniata*) and Darwin stringybark (*Eucalyptus tetradonta*). Lancewood (*Acacia shirleyi*) and bullwaddy (*Macropteranthes keckwickii*) display characteristics of rainforests and are found in wetter savannas. Mulgas, small acacia trees or shrubs, are highly drought-resistant and therefore, survive in drier Australian savannas. Tall grasses similar to those found in African savannas are common in Australia.

Vegetation in the Savanna Biome has developed adaptive mechanisms to tolerate the dry season and periodic fires. Some trees (e.g., the baobab tree) produce leaves only during the wet season and these leaves are small to limit water loss via evapotranspiration. The baobab tree also stores water in its large trunk to maintain reserves during periods of drought. Other adaptive mechanisms include developing long taproots that reach to deep ground water sources. Mulga trees use this approach with a two-layered root system – a surface layer to collect light rainfall and another layer deep below the surface to obtain deep-water sources. Additionally, the mulga's crown and branches are shaped to collect and direct rainfall efficiently. Many grasses and trees of the Savanna Biome are fire-resistant and flourish during the wet season and then enter a state of dormancy during periods of drought.

Wildlife

Geographic differences also determine the animal species present in the Savanna Biome. Typical South and Central American savanna wildlife include pumas (*Puma concolor*), jaguars (*Panthera onca*), giant anteaters (*Myrmecophaga tridactyla*), giant armadillos (*Priodontes maximus*), tapirs (*Tapirus spp.*), rodents (*Akodon dayi*, *Kunsia tomentosus*, *Oxymyceterus inca*), opossums (*Monodelphis kunsi*, *Marmosops dorothea*, *Lutreolina crassicaudata*), and bats (*Vampyrum spectrum*, *Phyllostomus hastatus*, *Micronycteris behnii*). Common bird species are the jabiru (*Jabiru mycteria*), the great tinamou

(*Tinamus major*), and the savanna hawk (*Heterospizias meridionalis*). The blue-throated macaw (*Ara glaucogularis*) is a threatened bird species in this region.

African animal species include wildebeest (*Connochaetes taurinus*), warthog (*Phacochoerus aethiopicus*), zebra (*Equus burchelli*), rhinoceros (*Diceros bicornis* [black], *Ceratotherium simum* [white]), giraffe (*Giraffa camelopardalis*), gazelle (*Gazella spp.*), hyena (*Crocuta crocuta*), ostrich (*Struthio camelus*), mousebird (*Colius spp.*), starling (*Sturnus spp.*), and weaver (*Ploceus spp.*). Threatened species include the African elephant (*Loxodonta Africana*), wild dog (*Lycaon pictus*), cheetah (*Acinonyx jubatus*), leopard (*Panthera pardus*), and lion (*Panthera leo*).

Animal species found in Australian savannas are largely endemic to this region. Mammal fauna include numerous species of wallaby (spectacled hare-wallaby [*Lagorchestes conspicillatus*], northern nailtail wallaby [*Onychogalea unguifera*], bridled nailtail wallaby [*Onychogalea fraenata*]), red (*Macropus rufus*) and gray (*Macropus giganteus*) kangaroos, dingos (*Canis lupus dingo*), fawn antechinus (*Antechinus bellus*), antilopine wallaroo (*Macropus antilopinus*), and several species of skinks (*Mabuya spp.*). Reptiles may include copper or brown mulga snake (*Pseudechis australis*), Oenpelli python (*Nyctophilopython oenpelliensis*), Ord Curl Snake (*Suta ordensis*), Kings' goanna (*Varanus kingorum*), and the agamid lizard (*Cryptagama aurita*). Common bird species are the Australian bustard (*Ardeotis australis*), grey falcon (*Falco Hypoleucos*), pigeons (chestnut-quilled rock pigeon [*Petrophassa rufipennis*], pied imperial pigeon [*Ducula bicolor*], orioles (*Oriolus spp.*), cuckoos (*Cuculus spp.*), lorikeets (*Charmosyna spp.*), and the Australasian shoveler (*Anas rhynchotis*). Black-striped wallaby (*Macropus dorsalis*), yellow-footed rock wallaby (*Petrogale xanthopus*), purple-crowned fairy-wren (*Malurus coronatus*), and wingless dung beetle (*Onthophagus apterus*) are examples of threatened animal species in Australian savannas.

Animal species must also be adaptive to the seasonal drought and fires of the Savanna Biome. Many of the large mammals and most birds migrate during the dry season in search of water. While elephants are migratory, they have a unique physical strength and anatomy that enables them to tear open the large trunks of acacia trees that contain water. Burrowing animals remain dormant during times of drought. The ability to fly or to run fast enables most birds and large mammals to escape from fire, while burrowing animals survive by digging underground and waiting for the flames to pass them by. Termites and ants often build mounds throughout the Savanna Biome in all continental regions.

Environmentally Sensitive Habitat

The pressure of expanding human settlement and the resulting loss of critical habitat threaten many of the species found in the Savanna Biome. The preservation of land as National Parks, Wildlife Refuges, and Game Reserves forms the cornerstone of regional conservation strategies to protect biodiversity. (Margules and Pressey 2000) Threatened and endangered vegetative and wildlife species of the Savanna Biome can be found in approximately fifty parks and reserves in eleven countries throughout Africa. (ThinkQuest 1998) Thirty-four National Parks protect environmentally sensitive savanna habitat in the Northern Territory and Queensland, Australia. (Australian Tourism Net 2005) Critical habitat in the Savanna Biome also benefits from the conservation efforts of non-profits organizations and academic research institutions. Those actively working in this area include Conservation International, Earthwatch, the Smithsonian Institution and the National Zoo, the Neotropical Grassland Conservancy, the Tropical Savannas Cooperative Research Center, and the World Conservation Union.

H.8.4 Geology and Soils

Geology

Savannas are similar to grasslands in geologic and topographic features, predominantly characterized by flat terrain and may be marked with escarpments and other plateau-like features of sandstone or limestone composition.

Soils

Savannas typically have porous (often sandy) soil, with only a thin covering of nutrient-rich humus and an overall low concentration of nutrients. Some soils have a hard crust that is subject to cracking, which allows trees to send their roots down to water held deep beneath the surface. Termite and ant mounds are common throughout savanna plains, and their inhabitants are important for soil formation. Coastal soils tend to be better drained relative to inland soils.

Geological Hazards

There are no significant widespread geological hazards throughout the Savanna Biome.

H.8.5 Hazardous Materials and Hazardous Waste

Missile facilities generate batteries, battery acid, paint and solvent wastes, and sodium chromate solution and rags. Hazardous wastes also are generated at deployment area facilities. For example, spent sodium chromate solution, rags used to handle the solution, and rags or gloves used to handle sodium chromate are wastes generated during daily routine operations and maintenance of the missile system.

Hazardous Materials

There are no existing facilities proposed for use in the BMDS in the Savanna Biome. However, future sites would use hazardous materials similar to those in use at existing sites discussed in this chapter and would produce similar hazardous wastes.

Hazardous Waste

Any future facilities that may be used as part of the proposed BMDS would adhere to all applicable legal requirements for hazardous materials and hazardous waste management as described in Section 3.1.7.

H.8.6 Health and Safety

Health and Safety attributes of the Savanna Biome are similar to those discussed in Section H.1.6.

H.8.7 Noise

Sources of noise in the Savanna Biome are similar to principle sources of noise associated with sites where activities for the proposed BMDS may occur, as described in the Section H.1.7.

H.8.8 Transportation

Transportation in the Savanna Biome is typically limited due to the frequently remote and rural nature of savannas. However, there are some cities located in the Savanna Biome such as Miami, Florida, and New Orleans, Louisiana.

Ground Transportation

Highways, if present, are typically unpaved and may not be regularly maintained due to the low volume of traffic carried and remote locations. Railways are not a dominant form of transportation in the Savanna Biome. Airports with paved runaways are scarce in the Savanna Biome.

Air Transportation

Airport facilities in this biome are likely to small in size, and support single engine planes. However, there are a few locations with major airports such as Miami International Airport, which handles more than 33 million passengers a year.

Marine Transportation

Navigable waterways are present in some wetter savannas and may be used to transport goods to ports along coastal savannas. Some major ports exist along the coastal regions of this biome, such as the Port of Miami that moved nearly 4 million passengers and over 9 million tons of cargo through the port in 2003.

H.8.9 Water Resources

Surface Water and Ground Water Resources

Riparian zones, although covering a small percentage of the total land area of the Savanna Biome, are vital to biodiversity, stream channel morphology, water quality, and the local economy. Within watersheds, savanna grasslands absorb rainfall, recharge aquifers, stabilize soils, and moderate run-off. However, savanna water resources are highly vulnerable to the effects of weed invasion, feral animals, overgrazing, and fire. Water resources are further strained by heavy water use in riparian areas for agriculture and tourism. (Douglas and Lukacs, 2004) For example, irrigated agriculture accounts for more than 70 percent of Australia's water use, and this water is increasingly extracted from ground water reserves. (Hutley, Eamus, and O'Grady, 1999)

During the wet season, rainfall is absorbed by the soil or becomes surface run-off. In wetter savanna regions during periods of heavy precipitation, the soil's absorptive capacity is quickly exceeded, and water drains from the soil, recharging shallow ground water aquifers or flowing into nearby streams. During the dry season, surface water resources are readily depleted, forcing plants to rely on deeper ground water supplies and animals to migrate to areas of more plentiful water. (Hutley, Eamus, and O'Grady, 1999)

Water Quality

Water quality problems most commonly are caused by livestock and feral animals during the dry season. During the wet season, large volumes of rain elicit surface water flow. Additionally, cattle tend to be dispersed away from waterholes during the wet season. However, as the dry season progresses, water levels fall, surface flow ceases, and pressure from grazing cattle increases. Cattle and feral animals stir up bottom sediments in surface streams, which reduces water clarity, thereby limiting the penetration of sunlight and in turn, the growth of aquatic plants. (Cooperative Research Centre for Tropical Savannas Management, 2003)

H.9 Mountain Biome

As shown in Exhibit 3-19, Volume 1, the Mountain Biome includes the mountainous regions of North America and Europe, which include the Rocky Mountains in the western

U.S. and the Alps in central Europe. The description in this section is representative of this biome throughout the world. Mountain biomes are found at high altitudes and lie just below and above the snow line of a mountain. Existing inland sites in the Mountain Biome include Buckley AFB, Cheyenne Mountain AFB and Fort Carson Military Reserve, Colorado; and F.E. Warren AFB, Wyoming. It is not reasonably foreseeable that activities for the proposed BMDS will occur on coastal locations within the Mountain Biome.

H.9.1 Air Quality

Climate

The Mountain Biome, often referred to as the Alpine biome, Tundra biome, or Alpine Tundra biome, encompasses the high mountain regions of the world and accounts for approximately one-fifth of the world's landscape. This biome occurs at high altitudes and lies just below and above the snow line of a mountain. Given its high altitude, the Mountain Biome is characteristically cold with heavy snowfall and frequently bitter winds. Temperatures remain below freezing for at least seven months of the year, and in the summer, average temperatures range from 10°C to 15°C (50°F to 59°F). Nighttime temperatures are almost always below freezing (0°C [32°F]). The average precipitation across mountain biomes is 30 centimeters (11.8 inches) a year. The seaward sides of mountain ranges receive rain or snow from moist oceanic air masses, whereas the interior sides are typically arid.

The Rocky Mountains in western North America are representative of the Mountain Biome as a whole, and the majority of sites where activities for the proposed BMDS may occur are located within this mountain range. The Rocky Mountain range lies at 35 degrees north to 60 degrees north latitude and 115 degrees east to 165 degrees east longitude. The Rocky Mountains experience unpredictable weather, which can change rapidly. As with other mountain climates, the climate changes with increasing altitude. In general, the Rockies have mild summers, cold winters, and large amounts of precipitation. The seasons differ drastically from one another. In the winter, deep snow, high winds, and sudden blizzards are common, whereas spring is characterized by unpredictable weather and may be wet or dry, cold or warm. In the summer, there are sunny mornings, afternoon thunderstorms, and clear nights. The fall has cool days, wind, and decreasing precipitation.

The average annual temperature in the Rocky Mountains is 6°C (43°F), with a winter average temperature of –2°C (28°F) and a summer average temperature range of 10°C to 15°C (50°F to 59°F). In the spring, the temperature averages 4°C (40°F), and the fall average temperature is 6°C (44°F). The highest temperature is 28°C (82°F) in July, while the lowest temperature is -14°C (7°F) in January.

The average precipitation per year is 36 centimeters (14 inches). The average winter precipitation is 3.6 centimeters (1.4 inches), and the summer receives 15 centimeters (5.9 inches) of precipitation on average. In the spring, an average of 10.7 centimeters (4.2 inches) of precipitation falls across the Rocky Mountains, and the fall averages 6.6 centimeters (2.6 inches) of precipitation.

Regional Air Quality

Mountain Biomes exhibit particular sensitivity to air pollution via deposition of both wet and dry pollutants, principally in snowpacks, which can in turn result in reduced surface water quality. Regional air pollutants of concern to mountainous areas include visibility-reducing PM, deposition of nitrogen and sulfur compounds, ozone, greenhouse gases that contribute to localized warming, and air toxics such as mercury and persistent organic pollutants. An emerging air quality concern is the issue of the effects of CO_2 and other toxics released from prescribed burns meant to actively manage the forested regions lying below the Mountain Biome. (Tonnessen, 2003) Another air quality issue unique to the Mountain Biome is increasing UV-B radiation, which affects human and ecological health. (Welch, 2002)

Existing Emission Sources

Typical sources of air pollutants in the Mountain Biome include population centers, energy development and power plants, and agricultural. Global emissions of air pollutants such as mercury, dioxin, pesticides, and polychlorinated biphenyls result in deposition to high elevation areas due to the "cold condensation" effect, which permits pollutants to partition out of air and into water as air masses cool as they rise in elevation. (Tonnessen, 2002)

H.9.2 Airspace

Controlled and Uncontrolled Airspace

The U.S. Mountain Biome contains all FAA classifications for airspace, as described in Section 3.1.2. The Denver ARTCC, located within the U.S. Mountain Biome, has the responsibility for maintaining separation between aircraft, which operate on IFR within this geographical area. The Center's area is divided into sectors. Low altitude sectors control from the ground to FL 260 (7,925 meters [26,000 feet]); high altitude sectors control FL 270 (8,230 meters [27,000 feet]) and above. From one to three controllers may work a sector, depending upon the traffic density. Controllers have direct communication with pilots, with surrounding sectors and Centers, plus the Towers and Flight Service Stations under their jurisdiction.

Special Use Airspace

The Denver ARTCC designates special use and restricted airspace for the Rocky Mountain region. Potential sites in the Mountain Biome where BMDS activities could occur would coordinate test events with the ARTCC to ensure that appropriate NOTAMs are issued.

Airports/Airfields

Civilian, military, and private airports exist in the Mountain Biome.

En Route Airways and Jet Routes

Civilian aircraft generally fly along established flight corridors that operate under VFR. Numerous Minimum En route Altitudes are present in the Grasslands Biomes. The airway and jet route segments in this Biome lie within airspace managed by the Denver ARTCC.

H.9.3 Biological Resources

Vegetation

Mountain Biomes are located at elevations too high to support the growth of trees; however, about 200 species of mountain plants are able to withstand the harsh climatic conditions of the Mountain Biome. The Mountain Biome is typically covered with a single dense layer of vegetation, usually only a few centimeters or decimeters in height. At high altitudes, there is very little CO_2, which plants need to perform photosynthesis. Because of the cold and wind, most species are slow-growing perennials (lasting for three growing seasons or more, as opposed to annuals that die and grow back year after year) and plants that have been forced to adapt to such an extreme environment. Plants protect themselves from the cold and wind by "hugging" the ground. Some plants have waxy coatings or hairs for minimal loss of heat and water to the wind.

Dominant plants tend to be dwarf perennial shrubs, sedges, grasses, mosses, and lichens. Alpine Phacelia (*Phacelia sericea*), Bear Grass (*Xerophyllum tenax*), Moss Campion (*Silen acaulis*), and Pygmy Bitterroot (*Lewisia pygmaea*) are all commonly found throughout the Mountain Biome. Despite their generally low productivity during most of the year, mountain plants exhibit bursts of productivity during the short growing season, lasting up to 180 days.

Wildlife

Mountain animals have to tolerate cold temperatures and intense ultraviolet radiation. Due to the high altitude, the atmosphere is thinner in the Mountain Biome, allowing more UV wavelengths to penetrate to the ground surface. Because of the year-round cold, only warm-blooded animals can survive in the Mountain Biome, although insects also exist.

Some lakes in the Mountain Biome support a small but unique assemblage of freshwater fishes, including Arctic Grayling (*Thymallus arcticus*), Lake Trout (*Salvelinus namaycush*), and Burbot (*Lota lota*). Many lakes and streams in the interior mountains freeze severely in winter, often to the bottom. Consequently, habitat becomes extremely limited in winter, and fish may become concentrated in small areas of rivers and at the bottoms of lake basins. Mountain lakes also support small numbers of breeding waterfowl, primarily ducks, during the summer. Golden Eagles (*Aquila chrysaetos*) and Merlins (*Falco columbarius*) commonly breed in the Mountain Biome, and Gyrfalcons (*Falco tinnunculus*) and Peregrine Falcons (*Falco peregrinus*) may nest where suitable cliff-nesting habitats are available.

Mountain animals adapt to the cold by hibernating, migrating to lower, warmer areas, or insulating their bodies with layers of fat. They also tend to have shorter appendages, including legs, tails, and ears, than their relatives in warmer environments to reduce heat loss. In addition, mountain animals have larger lungs, more blood cells, and more hemoglobin to combat the increased atmospheric pressure and lack of oxygen found in higher altitudes.

Two endangered animal species that may be found in the Mountain Biome are the Black-footed ferret (*Mustela nigripes*) and the Least tern (*Sterna antillarum*). A full list of endangered species under the Endangered Species Act may be found at the USFWS website (http://endangered.fws.gov). The web site allows the user to search for threatened and endangered species by geographic location and species name.

Environmentally Sensitive Habitat

Several mammals of the Mountain Biome, including the Dall Sheep (*Ovis dalli dalli*), Collared Pika (*Ochotona collaris*), Arctic Ground Squirrel (*Spermophilus parryii*), and Singing Vole (*Microtus montanus*), occur only in the state of Alaska and northwest Canada. These species survived the last glaciations in this region and are adapted to the short summers and long winters of their mountain habitats. These mammals are considered sensitive species and may warrant special conservation measures.

H.9.4 Geology and Soils

Geology

The Mountain Biome is a complex network of mountain ranges characterized by extreme physiographic variability. Wide differences in elevation, slope steepness, and exposure exist locally and between major mountain masses. The Mountain Biome occurs at high altitudes and lies just below and above the snow line of a mountain.

Soils

Much of the Mountain Biome appears as barren rock or a cover of thin soils. Soils in the biome are relatively fragile and are subject to erosion when disturbed. The cold weather of the Mountain biome delays decomposition of plant material therefore, mountainous soils typically do not contain many nutrients. Soils on steep or rocky slopes have had less time to develop. These younger soils occupy roughly 12 percent of the U.S. land area. Soils with similar characteristics to the arid grassland soil can also be found in mountainous areas, where the soil has accumulated clays, calcium carbonate, silica, and salts. This type of soil occupies roughly eight percent of the U.S. land area and is used mainly for range, wildlife, and recreation. Because of the dry climate in which they are found, they are not used for agricultural production unless irrigation water is available.

Geological Hazards

Mountain Biomes are subject to numerous geological hazards, including earthquakes, landslides, and volcanoes. Exhibits 3-5, 3-6 and H-7 show the geographic distribution for such hazards in the continental U.S.

H.9.5 Hazardous Materials and Hazardous Waste

Hazardous Materials

Maintenance support and flight support operations at Ranges or installations within the Mountain Biome use products containing hazardous materials, which include solvents, oils, lubricants, batteries, fuels, surface coatings, and cleaning compounds. These products are used and stored at locations throughout the base, but are found primarily in the industrial and maintenance facilities. Procedures are developed for hazardous material management.

Hazardous Waste

Hazardous waste generated at specific BMDS installations typically is associated with equipment maintenance. Wastes generated by the facility include oils, fuels, antifreeze,

paint, paint thinner and remover, photo chemicals, pesticides, aerosol canisters, batteries, used acetone, sulfuric acid, and sewage sludge. Procedures are developed for managing hazardous wastes at sites where activities for the proposed BMDS may occur. Due to the extreme climate of this biome, special measures may be necessary for storage and handling of hazardous materials and hazardous wastes in mountain areas.

H.9.6 Health and Safety

Health and Safety attributes of the Mountain Biome are similar to those discussed in Section H.1.6.

H.9.7 Noise

Sources of noise in the Mountain Biome are similar to principle sources of noise associated with sites where activities for the proposed BMDS may occur, as described in Section H.1.7.

H.9.8 Transportation

Mountain areas in central Europe sustain widespread infrastructure, including traffic circulation systems such as highways and byways, unpaved roads, non-maintained roads, trails, railroad lines, municipal, private, and military airports and any other system involved in mass transportation.

Ground Transportation

The sites where activities for the proposed BMDS may occur in the Mountain Biome are concentrated in Colorado, predominantly in the Colorado Springs area (Fort Carson Military Reserve, Peterson AFB, Schriever AFB). U.S. Interstates 70 and 25 are major arteries serving this region, as are U.S. Highway 24 and (Colorado) State Highways 94 and 115.

I-25, a four-lane freeway that meets most of the Federal standards established for the interstate system, connects Colorado Springs with urban centers to the north (Denver) and south (Pueblo). I-25 is currently undergoing a major modernization effort, called the I-25 Corridor Improvements Project, to upgrade an outdated, aging interstate facility through the construction of improved interchanges and roadways.

The east-west I-70 Mountain Corridor is a 225-kilometer (140-mile) stretch of rural, mountainous roadway that serves as a major intra- and inter-state highway. A PEIS is currently being prepared to address needed mobility improvements and congestion-reducing measures along the roadway. (Colorado DOT, 2003)

Air Transportation

Due to the extreme cold and heavy snowfall characteristic of the Mountain Biome, airports within this region require the ability to provide landing access under zero visibility conditions such as blizzards and de-icing capability.

Marine Transportation

Given the location of the Mountain Biome away from the coast, marine transportation is not a major source of transportation in this biome.

H.9.9 Water Resources

Surface Water and Ground Water Resources

Surface water resources in the Mountain Biome include glacial lakes, streams, and rivers fed by rainfall and melting snow or that originate from ground water sources. The water in mountain regions usually is clear with moderate amounts of nutrients provided from rain and melting snow runoff.

The Rocky Mountains of the western U.S. are characteristic of the water supply and uses found throughout the Mountain Biome. The Rocky Mountain region is arid to semi-arid with limited water resources. The watershed of the Rocky Mountains is known as the Great Basin. While agriculture is the biggest consumer of area water supply, draining approximately 80 percent of the total available water, urban, industrial, recreational, and historic Native American rights are intensifying competition for water. All available water is already allocated to some designated use; therefore, the watershed cannot readily support any extra demand on the region's water supply.

About 85 percent of the water used by the population of the Great Basin is derived from surface water, namely streams. Approximately three-fourths of the region's stream flow originates from melt and runoff of the yearly snowpacks found in the higher elevations of the Rockies. These snowpacks are the sources of many of the U.S.'s rivers, including the Missouri, Yellowstone, Platte, Arkansas, Rio Grande, Colorado, and Snake. Rocky Mountain waters flow into the Mississippi and Columbia River systems, and subsequently into the Pacific Ocean, the Gulf of Mexico, and the Gulf of California. Thus, the Great Basin contributes to the water needs of municipalities outside the region, including Los Angeles and San Diego, California; Phoenix, Arizona; and Albuquerque, New Mexico. Most of the Great Basin is an interior drainage basin. Therefore, its streams typically do not reach the oceans, largely draining internally into the Great Salt Lake and numerous playas (seasonally dry lakebeds). (USGCRP, 2003)

Europe abstracts a relatively small portion of its total renewable water resources each year. Total water abstraction in the region is about seven percent of the total freshwater resource. Resources are unevenly distributed across the region, and even if a country has sufficient resources at the national level there may be problems at regional or local levels. Agriculture accounts for 50 to 70 percent of total water abstraction in southwestern Europe, while cooling for electricity production is the dominant use in central Europe.

Water Quality

The National Water Quality Inventory summarizes the water quality assessments performed by state, local and Tribal governments. (EPA, 2000a) Water quality standards consist of three elements: (1) designated uses assigned to a water body (e.g., drinking, swimming, and fishing); (2) criteria to protect the designated use (e.g., chemical specific threshold limits); and (3) antidegradation policy to prevent deterioration of current water quality.

In the Mountain Biome, elevated levels of contaminants accumulate in snowpacks, negatively impacting local flora and fauna. Upon melting, the concentrated pollutants are dispersed throughout the area watershed, deteriorating the quality of downstream surface and ground water systems. U.S. Geological Survey studies indicate that concentrations of ammonium, nitrate, and sulfate (contaminants of particular concern for their tendency to form acid precipitation) are higher in heavily developed areas. The highest concentrations of nitrate and sulfate in the Rocky Mountain region are found in snowpacks that lie adjacent to both the highly developed Denver metropolitan area to the east and coal-fired power plants to the west. Ammonium concentrations are highest in northwestern Wyoming and southern Montana. (USGS, 2003)

Mining and agriculture are two other activities common in the Rockies that can degrade water quality. Concentrations of cadmium and zinc in streambed sediment are generally orders of magnitude higher than background concentrations. These elevated concentrations in turn degrade fish communities and habitat conditions. Agricultural areas often exhibit higher concentrations of nutrients and selenium than background levels. (USGS, 1999)

The European Union monitors surface water quality and drinking water quality via the 1976 Council Directive 76/160/EEC on Bathing Water Quality and the 1998 Council Directive 98/83/EC on the Quality of Water Intended for Human Consumption, respectively. Due to the outdated content of the former directive, the European Commission adopted a proposal for a revised directive (COM(2002)581) in October of 2002. Though this revision uses only two bacteriological indicators, Intestinal Enterococci and Escherischia coli, it sets a higher health standard than the existing directive. The directive uses these bacteriological indicators to provide bathing water quality goals and maximum bacterial concentrations, and pH to measure bathing water

acidity, in a quantitative manner. The remaining parameters (phytoplankton blooms or micro-algae proliferation, mineral oils, tarry residues and floating materials) offer a qualitative measure of the minimal allowable bathing water quality.

Water quality is a serious environmental issue across Europe. While water pollution is a particularly critical issue in Central and Eastern Europe, water abstraction (extraction) for public use is a primary concern in Western Europe.

In the 1970s and 1980s, freshwater surface water and ground water sources throughout Europe suffered eutrophication when they became flooded with organic matter, nitrogen from fertilizer, and phosphorous from industrial and residential wastewater. In recent decades, however, water quality improvements have been made across Europe. In Western Europe, phosphorous discharge from urban wastewater treatment plants has decreased by 50 to 80 percent since the 1980s. In Central and Eastern Europe, 30 percent to 40 percent of households were not yet connected to sewer systems as of 1990, and water treatment in this area was still inadequate. Improved efficiency for domestic and industrial water use in Western Europe decreased water abstraction for public water supply by eight to ten percent from 1985 through 1995. (UNEP, 2002)

H.10 Broad Ocean Area

For the purposes of this PEIS, the BOA encompasses the Pacific Ocean, the Atlantic Ocean, and the Indian Ocean.

Proposed activities in the BOA would take place at a distance of several hundred kilometers from any land mass. The BOA is subject to EO 12114, *Environmental Effects Abroad of Major Federal Actions,* which requires consideration of Federal actions abroad with the potential for impacts to the environment. The EO specifically defines environment as "the natural and physical environment, and excludes social, economic, and other environment." Therefore, potential impacts to environments other than the natural and physical area not analyzed in this document.

The Pacific Ocean is comprised of approximately 155.6 million square kilometers (60.1 million square miles) and includes the Bali Sea, Bering Sea, Bering Strait, Coral Sea, East China Sea, Flores Sea, Gulf of Alaska, Gulf of Tonkin, Java Sea, Philippine Sea, Savu Sea, Sea of Japan, Sea of Okhotsk, South China Sea, Tasman Sea, Timor Sea, and other tributary water bodies. Its maximum length is 14,500 kilometers (9,000 miles) and its greatest width is 17,700 kilometers (11,000 miles), which lies between the Isthmus of Panama and the Malay Peninsula. (Encyclopedia.com, 2003)

The Atlantic Ocean is comprised of 76.8 million square kilometers (29.6 million square miles) and includes the Baltic Sea, Black Sea, Caribbean Sea, Davis Strait, Denmark Strait, part of the Drake Passage, Gulf of Mexico, Mediterranean Sea, North Sea,

Norwegian Sea, almost all of the Scotia Sea, and other tributary water bodies. The Atlantic Ocean extends from the North Pole southward for 16,093 kilometers (10,000 miles) to the Antarctic continent. The width of the Atlantic varies from about 2,850 kilometers (1,770 miles) between Brazil and Liberia to approximately 4,830 kilometers (3,000 miles) between Norfolk, VA, and Gibraltar. The average depth is 3,660 meters (12,000 feet) and the greatest depth is approximately 8,650 meters (28,400 feet) in the Puerto Rico Trench. (Oceans of the World, 2003)

The Indian Ocean is comprised of approximately 68 million square kilometers (26 million square miles) and includes the Andaman Sea, Arabian Sea, Bay of Bengal, Great Australian Bight, Gulf of Aden, Gulf of Oman, Mozambique Channel, Persian Gulf, Red Sea, Strait of Malacca, and other tributary water bodies. It is triangular and bordered by Africa, Asia, Australia, and the Southern Ocean. Its maximum width is about 10,000 kilometers (6,200 miles) between the southernmost portions of Africa and Australia, and its average depth is about 3,900 meters (12,750 feet). The greatest depth occurs in the Java Trench at 7,300 meters (23,800 feet) below sea level. (Oceans of the World, 2003)

H.10.1 Air Quality

Two kinds of circulation create the currents in the ocean, wind-driven circulation and Thermohaline circulation. Wind-driven circulation results from the wind setting the surface waters into motion as currents. The currents generally flow horizontally or parallel to the earth's surface. The wind mainly affects only the upper 100 to 200 meters (328 to 656 feet) of water; however, the flow of wind-driven currents may extend to depths of 1,000 meters (3,280 feet) or more. (University of Washington, Department of Atmospheric Sciences, 2003) Thermohaline circulation produces great vertical currents that flow from the surface to the ocean bottom and back. The currents largely result from differences in water temperature and salinity. The currents move sluggishly from the polar regions, along the sea floor, and back to the surface.

Climate

Because oceans have great capacity for retaining heat, maritime climates are moderate and free from extreme seasonal variations. The oceans are the major source of the atmospheric moisture that is obtained through evaporation. Climatic zones vary with latitude and the warmest climatic zones stretch across the Atlantic, north of the equator. Ocean currents contribute to climatic control by transporting warm and cold waters to other regions. Adjacent land areas are affected by the winds that are cooled or warmed when blowing over these currents.

Pacific Ocean

The atmosphere and ocean continually interact in physical and chemical cycles in the eastern portion of the Pacific. Ocean surface temperatures play a large role in atmospheric conditions. A daily cycle of solar heat drives convective mixing, which occurs as a result of changes in water stability. In this case, the surface water sinks and the subsurface water rises to the surface, thus creating a mixing effect. Regional trade winds from the east push equatorial surface water into a mound in the west-equatorial Pacific Ocean that affects atmospheric conditions. The trade winds occasionally weaken, causing a reverse flow of warm surface waters to the east, which then mound against South America. The additional pressure of warm water in the east-equatorial Pacific Ocean inhibits and slows the upwelling of the more dense, cold, and nutrient-rich deep ocean water (DOT, 2001b) in a phenomenon known as the El Nino/Southern Oscillation. The El Nino effect includes an extreme decline in ecosystem productivity along the coast of South America and great fluctuations in heat transfer and molecular exchange between the ocean and the atmosphere throughout the Pacific region. (DOT, 2001b)

Winds and currents in the Pacific flow predominantly from East to West. Above the equator Pacific Ocean trade winds blow from the northeast, while below the equator, they blow from the southeast. Across the equatorial Pacific, prevailing trade winds push warm surface waters westward from Ecuador toward Indonesia. Deep, cold waters off the coast of South America rise, creating an east-west temperature contrast. That, in turn, lowers air pressure in the west, which draws in winds from the east.

Tropical cyclones (hurricanes) may form south of Mexico from June to October and affect Mexico and Central America. (Oceans of the World, 2003) Weather patterns in the north Pacific Ocean can be influenced by landmasses. The western Pacific tends to be monsoonal; a rainy season occurs during the summer months, when moisture-laden winds blow from the ocean over the land; and a dry season occurs during the winter months, when dry winds blow from the Asian landmass back to the ocean. Tropical cyclones (typhoons) may strike southeast and east Asia from May to December. (Oceans of the World, 2003)

Atlantic Ocean

The temperatures of the surface waters, water currents, and winds influence the climate of the Atlantic Ocean and adjacent land areas. The Gulf Stream, for example, warms the atmosphere of the British Isles and northwestern Europe, and the cold water currents contribute to heavy fog off the coast of northeastern Canada and the northwestern coast of Africa. In general, winds tend to transport moisture and warm or cool air over land areas.

Precipitation over the Atlantic BOA varies between ten centimeters (four inches) per year in the subtropics, with minimum amounts occurring near St. Helena and the Cape Verde Islands, and more than 200 centimeters (79 inches) per year occurring in the tropics. The region of highest rainfall follows the Intertropical Convergence Zone in a narrow band along five degrees north. A second band of high rainfall, with values of 100 to 150 centimeters (39 to 59 inches) per year, follows the path of storm systems in the Westerlies of the North Atlantic from Florida (28 to 38 degrees north) to Ireland, Scotland, and Norway (50 to 70 degrees north). No significant decrease in annual mean precipitation is observed from west to east; however, rainfall is not uniform across the band through the year. Most of the rain near Florida falls during summer, whereas closer to Europe it rains mainly in winter. (Tomczak and Godfrey, 2001)

The Atlantic BOA demonstrates a large seasonal variation of northern hemisphere winds. Important seasonal changes in wind direction occur along the east coast of North America, which experiences offshore winds during most of the year but warm, alongshore winds in summer. As part of the North Atlantic circulation, warm surface water from the equatorial Atlantic in the Gulf of Mexico travels north-westward as the Gulf Stream into the North Atlantic before cooling and sinking. The sinking water, called the North Atlantic deep water, acts as a pulling force and maintains the strength of the Gulf Stream. The presence of the warm Gulf Stream influences the climate of Western Europe, keeping winter temperature many degrees warmer than they would be otherwise. The North Atlantic Westerlies enter the ocean from the northwest and bring cold, dry air out over the Gulf Stream. The Atlantic northeast trade winds blow surface waters toward the equator and are somewhat stronger in winter than in summer. Seasonal wind reversals, characteristic of monsoons, are of minor importance and limited to the Florida-Bermuda area in the Atlantic BOA. (Tomczak and Godfrey, 2001)

Tropical cyclones, or hurricanes, develop off the coast of Africa near Cape Verde and move westward into the Caribbean Sea. Hurricanes can occur from May to December, but are most frequently observed from August to November. Storms are common in the North Atlantic Ocean during northern winters, making ocean crossings more difficult and dangerous. From October to May, ships may be subject to superstructure icing in extreme northern areas.

Indian Ocean

The climate of the Indian Ocean is marked by seasonal monsoons, which are seasonally shifting winds that produce either heavy precipitation or dry conditions, depending on the direction of the winds. (Virtual Domain Application Data Center, 2004) Low atmospheric pressure over Southwest Asia from rising hot summer air results in the southwest monsoon, which brings heavy rainfall from June to October. Cold, falling winter air builds high-pressure systems over northern Asia that contributes to the dry northeast monsoon from December to April. (CIA, 2003) Differential heating between

the land and ocean and the storage and subsequent release of energy that occurs as water changes from liquid to vapor and back (latent heat) intensifies the effects of the Indian Ocean Monsoon more than any other place in the world. (Virtual Domain Application Data Center, 2004)

Similar to the El Nino effect in the Pacific Ocean, the Indian Ocean experiences an El Nino event, as well. A warm pool in the Indian Ocean moves eastward along the equator in a cycle of three to seven years. The warm pool migrates to the central Indian Ocean, where the warmest sea surface temperatures form, and then continues eastward to Indonesia and southward into the Timor Sea, north of Australia. The warm pool in the Indian Ocean propagates eastward along the equator more slowly than it does in the Pacific Ocean. (Columbia University Record, 1994)

Tropical cyclones occur during May and June and October and November in the northern Indian Ocean and during January and February in the southern Indian Ocean. (CIA, 2003) Cyclones also may occur in the Arabian Sea and the Bay of Bengal when monsoon winds change. (Wikipedia, 2003)

Regional Air Quality

No sources of ambient air quality monitoring data are known to exist for the BOA. Air quality over the Pacific Ocean is expected to be good because there are no major sources of air pollution, and the nearly constant trade winds in the area serve to disperse any pollutants from transient sources, such as passing seagoing vessels or low-flying aircraft. In the Atlantic Ocean, there is potential for large, thick plumes of aerosols blowing eastward over the North Atlantic. The aerosol plume is the regional haze produced by the industrial northeastern U.S. and typically occurs during the summer months. The haze is composed of sulfates and organics that originate from power plants and automotive sources. (NASA, 2003)

Air quality over the Indian Ocean is seasonally poor due to anthropogenic emissions from growing South and Southeast Asian countries, particularly India. During the dry monsoon season (northern hemisphere winter), air pollutants in South and Southeast Asia are transported long distances to the Indian Ocean by persistent northeasterly monsoon winds. A dense, brown haze covers an area greater than ten million square kilometers (3.9 million square miles) over most of the northern Indian Ocean (Max Planck Society, 2001), including the Arabian Sea, much of the Bay of Bengal, and part of the equatorial Indian Ocean to about five degrees south of the equator. (Environmental News Network, 1999) The haze extends from the ocean surface up to three kilometers (1.9 miles). Comprised primarily of soot, sulfates, nitrates, organic particles, fly ash, and mineral dust, the airborne particles can reduce visibility over the BOA to less than 10 kilometers (6.3 miles) and reduce the solar heating of the ocean by about 15 percent. The haze also

contains relatively high concentrations of gases, including CO, SO_2, and other organic compounds. (Environmental News Network, 1999)

Existing Emission Sources

There are no known existing emission sources in the Pacific Ocean. Ozone and other pollutants found in the Atlantic Ocean are primarily the result of anthropogenic sources. Agricultural, urban, and industrial production that occurs on continental landmasses surrounding the Atlantic Ocean may impact emission levels, as well as marine life. A monitoring station in the Maldives Islands records air quality in the Indian Ocean. (Environmental News Network, 1999) The aerosol cloud covering much of the northern Indian Ocean originates primarily (at least 85 percent) from anthropogenic sources (Max Planck Society, 2001), namely agricultural and other biomass burning, the use of biofuels, and fossil fuel combustion, in South and Southeast Asia. (Lelieveld et al., 2001) Model calculations indicate that, in contrast to European and North American pollution, anthropogenic emissions from South and East Asia reduce the concentration of hydroxyl (OH) radicals. Because OH is a powerful oxidant and acts as an atmospheric cleansing agent, the Asian pollution decreases the oxidizing power of the atmosphere, contributing to greater pollution problems over the Indian Ocean. (Max Planck Society, 2001)

H.10.2 Airspace

Controlled and Uncontrolled Airspace

Because the airspace in the BOA is beyond the territorial limit and is in international airspace, the procedures of the ICAO, outlined in ICAO Document 444, *Rules of the Air and Air Traffic Services* are followed. The FAA acts as the U.S. agent for aeronautical information to the ICAO. The Honolulu or Oakland ARTCC manages air traffic in the Pacific region of influence and the New York ARTCC manages the air traffic in the Atlantic region of influence. The Oakland Oceanic Flight Information Region is the world's largest, covering approximately 48.4 million square kilometers (18.7 million square miles) and handling over 560 flights per day.

Special Use Airspace

Domestic Warning Areas are established in international airspace to contain activity that may be hazardous and to alert pilots of nonparticipating aircraft to the potential danger. Special use airspace is established at PMRF, Warning Area W-188 north of Kauai, and Warning Areas W-189 and W-190 north of Oahu. There are numerous warning areas along the U.S. Pacific coastline.

Airports and Airfields

There are no airports or airfields located in the BOA.

En Route Airways and Jet Routes

Before conducting a missile launch, NOTAMs would be sent in accordance with the conditions of the directive specified in Operations Naval Instruction 3721.20. In addition, the responsible commander would obtain approval from the FAA Administrator, through the appropriate U.S. Navy airspace representative. Hazardous operations would be suspended when it is known that any non-participating aircraft has entered any part of the danger zone until the non-participating entrant has left the area or a thorough check of the suspected area has been performed.

High-altitude overseas jet routes cross the Pacific BOA via nine control area extension corridors off the California coast. These corridors and associated jet routes continue northwest to Alaska and then southwest to the Orient. These corridors can be opened or closed at the request of a user in coordination with the FAA. A Memorandum of Agreement exists between users and the FAA to stipulate the conditions under which the control area extensions can be closed to civil traffic. Under most circumstances, at least one control area extension must remain available for use by general aviation and commercial air carriers.

The FAA is gradually permitting aircraft to select their own routes as an alternative to flying above 8,830 meters (29,000 feet) following the published jet routes through a Free Flight program. The program is designed to enhance the safety and efficiency of the National Airspace System (NAS). The concept moves the NAS from a centralized command-and-control system between pilots and air traffic controllers to a distributed system that allows pilots, whenever practical, to choose their own route, and file a flight plan that follows the most efficient and economical route. (ICF Kaiser for Beal Aerospace, 1998)

The Free Flight program would become fully implemented once procedures are modified, and technologies become available and are acquired by users and service providers. Advanced satellite voice and data communications would be used to provide faster and more reliable transmission to enable reductions in vertical, lateral, and longitudinal separation, more direct flights and tracks, and faster altitude clearances. (ICF Kaiser for Beal Aerospace, 1998) With full implementation of this program, the amount of airspace in the region that is likely to be clear of traffic will decrease as pilots, whenever practical, choose their own route and file a flight plan that follows the most efficient and economical route, rather than following the published jet routes.

H.10.3 Biological Resources

Marine biology of the open ocean consists of the animal and plant life that lives in and just above the surface waters of the sea and its fringes; physical and chemical properties of the ocean; biological diversity; and the characteristics of its different ecosystems or communities.

The general composition of the ocean includes water, sodium chloride, dissolved gases, minerals, and nutrients. These characteristics determine and direct the interactions between the seawater and its inhabitants. The most important physical and chemical properties are salinity, density, temperature, pH, and dissolved gases. For oceanic waters, the salinity is approximately 35 parts of salt per 1,000 parts of sea water. Most organisms have a distinct range of temperatures in which they thrive. A greater number of species live within the moderate temperature zones, with fewer species tolerant of extremes in temperature. Most areas maintain a temperature of 4°C (39.2°F).

Surface sea water often has a pH between 8.1 and 8.3 (slightly basic), but generally is stable with a neutral pH. The amount of oxygen present in sea water will vary with the rate of production by plants, consumption by animals and plants, bacterial decomposition, and surface interactions with the atmosphere. CO_2 is a gas required by plants for photosynthetic production of new organic matter and is 60 times more concentrated in seawater than it is in the atmosphere.

Vegetation

Organisms inhabiting the open ocean typically do not come near land, continental shelves, or the seabed (DOT, 2001b). Marine plants and plant-like organisms can live only in the sunlit surface waters of the ocean, known as the photic zone, which extends to only about 101 meters (330 feet) below the surface. Beyond the photic zone, the light is insufficient to support plants and plant-like organisms. Animals, however, live throughout the ocean from the surface to the greatest depths. The organisms living in the open ocean communities may be drifters (plankton) or swimmers (nekton). These organisms make up approximately two percent of marine species populations. Plankton consists of plant-like organisms and animals that drift with the ocean currents, with little ability to move through the water on their own. Benthic, or sea floor, communities are made up of marine organisms, such as kelp, sea grass, clams, and other species that live on or near the sea floor.

Regulation of marine wildlife in the BOA is diverse and may involve Federal, state, local, or international agencies and organizations. A report by NOAA's National Marine Fisheries Service, Our Living Oceans (1999) covers the majority of living marine resources that are of interest for commercial, recreational, subsistence, and aesthetic or intrinsic reasons to the U.S.

Wildlife

Organisms inhabiting the open ocean typically do not come near land, continental shelves, or the seabed (DOT, 2001b). The organisms living in the open ocean communities may be drifters (plankton) or swimmers (nekton). These organisms make up approximately two percent of marine species populations. Nekton consists of animals that can swim freely in the ocean, such as fish, squids, and marine mammals. Benthic, or sea floor, communities are made up of marine organisms, such as kelp, sea grass, clams, and other species that live on or near the sea floor. The deep-sea benthic community, which lives a thousand to several thousand meters beneath open ocean waters, has been stable over long periods of geologic time and has allowed for the evolution of numerous highly specialized species. (DOT, 2001b) Less than one percent of benthic species live in the deep ocean below 2,000 meters (6,562 feet).

Regulation of marine wildlife in the BOA is diverse and may involve Federal, state, local, or international agencies and organizations. A report by NOAA's National Marine Fisheries Service, Our Living Oceans (1999) covers the majority of living marine resources that are of interest for commercial, recreational, subsistence, and aesthetic or intrinsic reasons to the U.S.

Sea turtles are highly migratory and widely distributed throughout the world's oceans. Six species of seas turtles are found in the U.S. and all are listed as endangered or threatened. The loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempi*), green (*Chelonia mydeas*), Olive ridley (*Lepidochelys olivacea),* green (*Chelonia mydeas)*, hawksbill (*Eretmochelys imbricate*), and leatherback (*Dermochelys coriacea*) commonly are found in BOA waters. The Kemp's ridley, hawksbill, and leatherback are listed as endangered throughout their ranges, while the loggerhead and green turtle are listed as threatened. The National Marine Fisheries Service report noted that ingestion of marine debris could be a serious threat to sea turtles. When feeding, sea turtles can mistake debris for natural food items. Plans are underway to prioritize actions that are necessary to conserve and recover the species. (NMFS, 1999)

Federally listed endangered species that exist within the BOA include the Sei Whale (*Balaenoptera borealis*), the Blue whale (*Balaenoptera musculus*), the Fin Whale (*Balaenoptera physalus*), the Humpback whale (*Megaptera novaengliae*), and the Sperm whale (*Physeter macrocephalus*). Threats to these species include commercial whalers, historic whaling practices, offshore drift gillnet fishing, and ship strikes.

Environmentally Sensitive Habitat

EO 13178 established the Northwestern Hawaiian Island Coral Reef Ecosystem Reserve, which lies to the northwest of the main islands of the Hawaiian chain, to "ensure the comprehensive, strong, and lasting protection of the coral reef ecosystem and related

marine resources and species of the Northwestern Hawaiian Islands." The Reserve includes submerged lands and waters of the Northwestern Hawaiian Islands, extending approximately 2,220 kilometers (1,200 nautical miles) long and 185 kilometers (100 nautical miles) wide. The Reserve also includes the Hawaiian Islands National Wildlife Refuge to the extent that it expands beyond the seaward boundaries of Hawaii. The seaward boundary of the Reserve is 93 kilometers (50 nautical miles) from the approximate geographical centerline of Nihoa, Necker, French Frigate Shoals, Gardner Pinnacles, Maro Reef, Laysan, Lisianski, Pearl and Hermes Reef, Midway Atoll, and Kure.

Congress created the Hawaiian Islands Humpback Whale National Marine Sanctuary in 1992. Humpback whales (*Megaptera novaeangliae*) are endangered marine mammals and are protected under provisions of the Endangered Species Act and the Marine Mammal Protection Act wherever they are found. In the winter months, Humpbacks are typically seen in the shallow waters surrounding the Hawaiian Islands, where they congregate to mate and calve. Regulations implementing designation of the sanctuary specifically recognize that all existing military activities external to the sanctuary are authorized, as are new military activities following consultation with the NOAA Fisheries Service. (62 FR 14816, 15 CFR 922.183)

H.10.4 Geology and Soils

Geology

Pacific Ocean

The Pacific Ocean floor of the central Pacific basin is relatively uniform, with a mean depth of about 4,270 meters (14,000 feet). The western part of the floor consists of mountain arcs that rise above the sea as island groups, such as the Solomon Islands and New Zealand, and deep trenches, such as the Marianas Trench, the Philippine Trench, and the Tonga Trench. Most of the deep trenches lie adjacent to the outer margins of the wide western Pacific continental shelf. (Encyclopedia.com, 2003) The Pacific Ocean floor is characterized by the Central Pacific Trough. This feature extends from the Aleutian Islands southward to Antarctica and from Japan to the west coast of North America. Along with a number of deep ocean trenches, the Pacific has many flat-topped seamounts called guyots. (Oceans of the World, 2003)

The approximately 20,000 islands in the Pacific Ocean are concentrated in the south and west. Most of the larger islands are structurally part of the continent and rise from the continental shelf; these include the Japanese island arc, the Malay Archipelago, and the islands of northwest North America and southwest South America. Scattered around the Pacific and rising from the ocean floor are high volcanic islands. Along the eastern margin of the Pacific basin is the East Pacific Rise, which is a part of the worldwide mid-

oceanic ridge. About 3,000 kilometers (1,800 miles) across, the rise stands about three kilometers (two miles) above the adjacent ocean floor. Because a relatively small land area drains into the Pacific, and because of the ocean's immense size, most sediments are authigenic (minerals that grow in place with a rock) or pelagic in origin. Pelagic deposits, which contain the remains of organisms that sink to the ocean floor, include red clays and Globigerina, pteropod, and siliceous oozes. Covering most of the ocean floor and ranging in thickness from 60 meters (200 feet) to 3,300 meters (10,900 feet), pelagic deposits are thickest in the convergence belts and in the zones of upwelling. Authigenic deposits, which are materials that grow in place with a rock, rather than having been transported and deposited, consist of such materials as manganese nodules and occur in locations where sedimentation proceeds slowly or currents sort the deposits. (Wikipedia, 2003)

The Earth's crust in the equatorial Pacific region is broken into roughly two-dozen plates, which create various features on the ocean floor, such as ridges, trenches, and volcanoes. (DOT, 2001b) The floor of the Pacific Ocean, which has an average depth of 4,300 meters (14,000 feet), is largely a deep-sea plain. The greatest known depth is the Challenger Deep in the Marianas Trench, which is 10,911.5 meters (35,798.6 feet) deep. (Encyclopedia.com, 2003)

Atlantic Ocean

The principal feature of the bottom topography of the Atlantic BOA is a great submarine mountain range called the Mid-Atlantic Ridge. It extends from Iceland in the north to approximately 58 degrees south latitude, reaching a maximum width of about 1,600 kilometers (1,000 miles). A great rift valley also extends along the Mid-Atlantic Ridge over most of its length. The depth of water over the ridge is less than 2,700 meters (8,900 feet) in most places, and several mountain peaks rise above the water, forming islands.

The Mid-Atlantic Ridge separates the Atlantic BOA into two large troughs with depths averaging between 3,660 and 5,485 meters (12,000 and 18,000 feet). (Oceans of the World, 2003)

The deep ocean floor of the Atlantic is thought to be fairly flat, although numerous seamounts and some guyots exist. Several deeps or trenches also are found on the ocean floor. The deepest elevation point is the Milwaukee Deep in the Puerto Rico Trench. The shelves along the margins of the continents constitute about 11 percent of the bottom topography. In addition, a number of deep channels cut across the continental rise.

Indian Ocean

The Mid-Ocean Ridge, a broad submarine mountain range extending from Asia to Antarctica, dominates the terrain of the Indian Ocean floor and divides the Indian BOA into three major sections – the African, Antardis, and Australasian. The ridge rises to an average height of approximately 3,000 meters (10,000 feet), and a few peaks emerge as islands. A large rift, an extension of the Great Rift Valley that runs through the Gulf of Aden, extends along most of the ridge's length.

The Indian Ocean is subdivided into a series of deep sea basins (abyssal plains) by the Southeast Indian Ocean Ridge, Southwest Indian Ocean Ridge, and Ninetyeast Ridge (CIA, 2003). The floor of the Indian Ocean has an average depth of approximately 3,886 meters (12,750 feet). The greatest depth occurs in the Java Trench at 7,258 meters (23,812 feet) below sea level. (Oceans of the World, 2003) Glacial outwash dominates the extreme southern latitudes. (Wikipedia, 2003)

Soils (Sediment)

Ocean sediments are composed of terrestrial, pelagic, and authigenic material. Terrestrial deposits consist of sand, mud, and rock particles formed by erosion, weathering, and volcanic activity on land and then washed to sea. These materials are largely found on the continental shelves and are thickest off the mouths of large rivers or desert coasts. Pelagic deposits, which contain the remains of organisms that sink to the ocean floor, include red clays and Globigerina, pteropod, and siliceous oozes. Covering most of the ocean floor and ranging in thickness from 60 meters (200 feet) to 3,300 meters (10,900 feet), pelagic deposits are thickest in the convergence belts and in the zones of upwelling. Authigenic deposits, which are materials that grow in place with a rock, rather than having been transported and deposited, consist of such materials as manganese nodules and occur in locations where sedimentation proceeds slowly or currents sort the deposits. (Wikipedia, 2003)

Geologic Hazards

The Pacific Ocean is surrounded by a zone of violent volcanic and earthquake activity sometimes referred to as the "Pacific Ring of Fire." Icebergs are common in the Davis Strait, Denmark Strait, and the northwestern Atlantic Ocean from February to August and have been spotted as far south as Bermuda and the Madeira Islands. (Oceans of the World, 2003) Occasional icebergs occur in the southern reaches of the Indian Ocean. (CIA, 2003)

H.10.5 Hazardous Materials and Hazardous Waste

Hazardous Materials

Test event sponsors would be responsible for safe storage and handling of the materials that they obtain and must adhere to all DOT hazardous materials transportation regulations. Hazardous materials used in support of test event activities would include propellants, various cleaning solvents, paints, cleaning fluids, fuels, coolants, and other materials. Releases of materials in excess of reportable quantities specified by CERCLA would be reported to the EPA. Material and Safety Data Sheets would be available at the use and storage locations of each material.

For test events using sea-based platforms, hazardous materials would be conducted in accordance with all applicable state and Federal regulations as well as Range-specific and U.S. Navy standard operating procedures.

The transport, receipt, storage, and handling of hazardous materials will adhere to the Army TM 38-410, Navy NAVSUP PUB 505, Air Force AFR 69-9, Marine Corps MCO 4450-12 or Defense Logistics Agency DLAM 4145.11, Storage and Handling and Implementing Regulations Governing Storage and Handling of Hazardous Materials.

Hazardous Waste

The Clean Water Act prohibits the discharge of hazardous substances into or upon U.S. waters out to 370 kilometers (200 nautical miles). Also shipboard waste handling procedures for commercial and U.S. Navy vessels govern the discharge of hazardous wastes as well as non-hazardous waste streams. These categories include "blackwater" (sewage); "greywater" (leftover cleaning water); oily wastes; garbage (plastics, non-plastics, and food-contamination); hazardous wastes; and medical wastes. (U.S. Department of the Navy, 2002b)

Under the regulations implementing the Act to Prevent Pollution from Ships, as amended, and the Marine Plastics Pollution Research and Control Act, the discharge of plastics, including synthetic ropes, fishing nets, plastic bags, and biodegradable plastics, into water is prohibited. A slurry of sea water, paper, cardboard, or food waste capable of passing through a screen with opening no larger than 12 millimeters (0.4 inch) in diameter may not be discharged within 5.6 kilometers (three nautical miles) of land. Discharge of floating dunnage, lining, and packing materials is prohibited in navigable waters and in offshore areas less than 46.3 kilometers (25 nautical miles) from the nearest land.

Test event sponsors would be responsible for tracking hazardous wastes; for proper hazardous waste identification, storage, transportation, and disposal; and for implementing strategies to reduce the volume and toxicity of the hazardous waste generated. For test events using a sea-based platform, hazardous materials and hazardous waste management would be conducted in accordance with all applicable state and Federal regulations as well as Range-specific and U.S. Navy standard operating procedures.

The transport, receipt, storage, and handling of hazardous materials would comply with Army TM 38-410, Navy NAVSUP PUB 505, Air Force AFR 69-9, Marine Corps MCO 4450-12 or Defense Logistics Agency DLAM 4145.11, Storage and Handling and Implementing Regulations Governing Storage and Handling of Hazardous Materials.

H.10.6 Health and Safety

The region of influence for health and safety in the BOA would be limited to work crews located on sea-based platforms. If noise exposures equal or exceed an 8-hour time-weighted average of 85 dB, personnel on the sea-based platform would be required to wear appropriate hearing protection equipment.

The WorldWide Navigational Warning Service is a worldwide radio and satellite broadcast system for the dissemination of Maritime Safety Information to U.S. Navy and merchant ships. The WorldWide Navigational Warning Service provides timely and accurate long range and coastal warning messages promoting the safety of life and property at sea and Special Warnings that inform mariners of potential political or military hazards that may affect safety of U.S. shipping. The world is divided into 16 Navigational Areas for global dissemination of Maritime Safety Information. National Imagery and Mapping Agency is the coordinator of Navigational Areas.

The International Maritime Organization is a specialized agency of the United Nations, whose objective is to develop and facilitate the general adoption of the highest practicable standards in matters of ship safety, training, operation, construction, and certification, efficiency of navigation, and pollution prevention and control. The Maritime Safety Committee is the organization's senior technical body on safety-related matters. The International Maritime Organization also has developed and adopted international collision regulations and global standards for seafarers, as well as international conventions and codes relating to search and rescue, the facilitation of international maritime traffic, load lines, the carriage of dangerous goods, pollution and tonnage measurement.

H.10.7 Noise

Baseline or ambient noise levels on the ocean surface are a function of local and regional wind speeds. Studies of ambient noise of the ocean have found that the sea surface is the

predominant source of noise, and that the source is associated with the breaking of waves. (Knudsen, et al., 1948, as referenced in DOT, 2001a) Wave breaking is further correlated to wind speed, resulting in a relationship between noise level and wind speed. (Cato, et al., 1994 as referenced in DOT, 2001) Seasonal changes in winds usually do not include changes in wind speed but rather wind direction. (NIMA, 1998, as referenced in DOT, 2001a) Storms and other weather events, however, would increase localized wind speed, and therefore would increase the noise level for the duration of that weather event.

Common sources of background noise for large bodies of water are tidal currents and waves; wind and rain over the water surface; water turbulence and infrasonic noise; biological sources (e.g., marine mammals); and human-made sounds (e.g., ships, boats, low-flying aircraft). The ambient noise levels from natural sources are expected to vary according to numerous factors including wind and sea conditions, seasonal biological cycles, and other physical conditions. Noise levels from natural sources can be as loud as 120 dB in major storms. (U.S. Army Space and Strategic Defense Command, 1994a)

The primary human-made noise source within the BOA is associated with ship and vessel traffic, including transiting commercial tankers and container ships, commercial fishing boats, and military surface vessels and aircraft. Noise sources also would include launch or other activities from sea-based platforms.

H.10.8 Transportation

The potential transportation issue related to the BOA is marine shipping.

Ground Transportation

Given the nature of the BOA, no ground transportation exists in this biome.

Air Transportation

Because no airfields are located in the BOA, air transportation is not associated with this biome. Several national and international commercial air traffic routes pass over the BOA.

Marine Transportation

Marine shipping refers to the conveyance of freight, commodities, and passengers via mercantile vessels. There are no regulations or directions obliging commercial vessels to comply with specific cross-ocean lanes. Once a commercial vessel has left the navigation lanes leading out to the open sea, the majority of shipping will follow the course of least distance between two ports.

As of January 1, 1999, the domestic fleet includes

- Domestic coastal and oceangoing vessels including 55 container ships, 104 tankers, 982 dry cargo barges, and 456 tank barges;
- An inland-barge fleet consisting of 22,279 dry cargo barges and 2,791 tank barges;
- A tug and towing system consisting of 5,424 vessels that move coastal and inland barges and provide ship docking, vessel escort, lightering, and other services;
- A Great Lakes system consisting of a fleet of 56 dry bulk carriers, eight cement carriers, three tankers, and an additional 101 dry cargo barges and 41 tank barges; and
- Hundreds of passenger vessels that serve as ferries, excursion vessels, and gaming vessels.

The Pacific and Atlantic oceans are important commercial seaways, carrying a substantial portion of the U.S. trade in raw materials and finished products. For example, in 1996, about 21 percent of all commercial vessels importing and exporting goods to and from the U.S. top 30 ports departed from, or were bound for, ports on the U.S. Pacific seaboard. (DOT, 1999)

The Indian Ocean provides major sea routes connecting the Middle East, Africa, and East Asia with Europe and the Americas. It carries a particularly heavy traffic of petroleum and petroleum products from the oilfields of the Persian Gulf and Indonesia. (CIA, 2003)

H.10.9 Water Resources

The two main factors that define ocean water are the temperature and the salinity of the water. Ocean water gets denser when either the temperature decreases or the salinity increases. (UCAR, 2001b)

Surface water temperatures vary with latitude, current systems, and seasons and reflect the latitudinal distribution of solar energy. Temperatures range from less than 2°C to 29°C (28°F to 84°F). Maximum temperatures occur north of the equator, and minimum values are found in the Polar Regions. In the middle latitudes, which is the area of maximum temperature variations, values may vary by 7°C to 8°C (13°F to 14°F). Surface seawater often has a pH between 8.1 and 8.3 (slightly basic), but generally is very stable with a neutral pH. The amount of oxygen present in seawater will vary with the rate of products by plants, consumption by animals and plants, bacterial decomposition, and surface interactions with the atmosphere.

Pacific Ocean

Water temperatures in the Pacific vary from freezing in the poleward areas to about 29°C (84°F) near the equator. Water near the equator is less salty than that found in the mid-latitudes because of abundant equatorial precipitation throughout the year. Poleward of

the temperate latitudes salinity is also low, because little evaporation of seawater takes place in these areas. The surface of the Pacific Ocean generally circulates clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere. (Wikipedia, 2003)

Atlantic Ocean

The salinity of the surface waters in the open ocean ranges from 33 to 37 parts per thousand and varies with latitude and season. Although the minimum salinity values are found just north of the equator, in general the lowest values are in the high latitudes and along coasts where large rivers flow into the ocean. Maximum salinity values occur at about 25 degrees north latitude. Surface salinity values are influenced by evaporation, precipitation, river inflow, and melting of sea ice. For example, poleward of the Westerlies, sea surface salinity decreases further as a result of freshwater supply from glaciers and icebergs. In subtropical areas, water with high salinity flows westward with the North Equatorial Current, and continuous evaporation further increases surface salinity. (Tomczak and Godfrey, 2001)

Effects on sea surface salinity are somewhat alleviated by the large land drainage area of the Atlantic BOA, which includes the American continent north of the equator, Europe, large parts of northern Africa, and northern Asia (Siberia). Many of the world's largest rivers, including the Mississippi and Rhine Rivers, empty into the Atlantic BOA, while others, such as the Nile and Kolyma Rivers, empty into its Mediterranean seas. In these adjacent seas, river runoff plays an important role in the salinity balance and consequently influences their circulation. Overall, however, the contribution from rivers to the freshwater flux of the Atlantic BOA cannot compensate for the low level of rainfall over the sea surface. (Tomczak and Godfrey, 2001)

Indian Ocean

Surface water temperatures in the Indian Ocean vary with the seasons and distance from the equator, but the ocean's mostly tropical waters do not exhibit the same temperature extremes found in the Atlantic and Pacific oceans. The surface waters are generally warm, with a minimum temperature of 22ºC (72ºF) north of 20 degrees south latitude. Surface water temperature may exceed 28ºC (82ºF) to the east. South of 40 degrees south latitude, temperatures drop quickly. Pack ice and icebergs are found year-round south of approximately 65 degrees south latitude; the average northern limit for icebergs is 45 degrees south latitude. (Wikipedia, 2003)

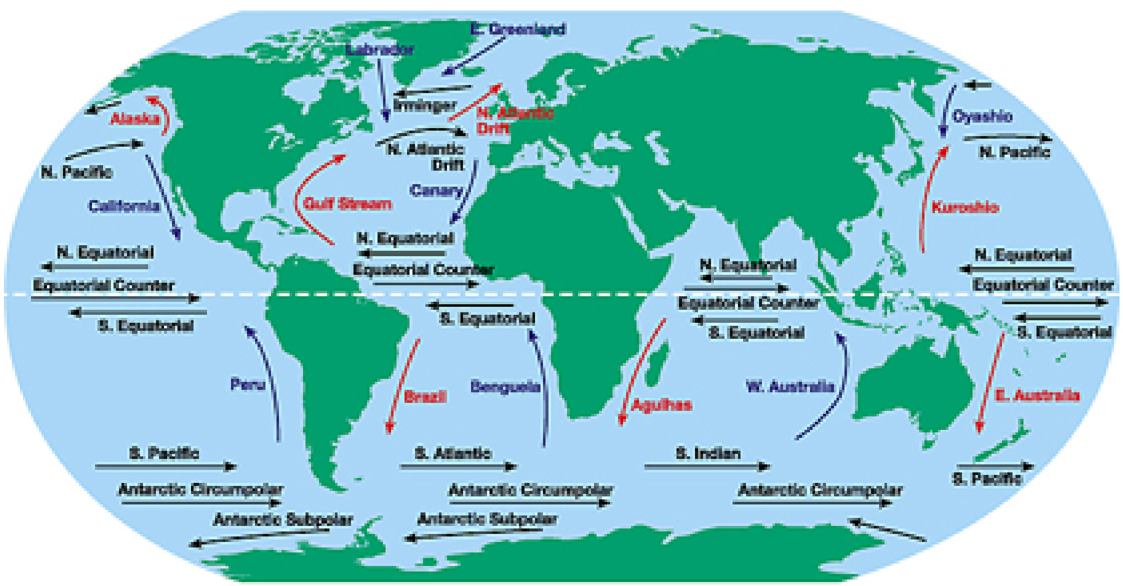
Surface water salinity ranges from 32 to 37 parts per thousand, the highest occurring in the Arabian Sea and in a belt between southern Africa and southwestern Australia. (Wikipedia, 2003) Rainfall anomalies and winds associated with monsoons and El Nino

events affect surface salinity in the Indian Ocean. (Perigaud, McCreary, and Zhang, 2003)

The Indian Ocean has two water circulation systems – a regular counterclockwise system in the southern hemisphere, including the South Equatorial Current, Mozambique Current, West Wind Drift, and West Australian Current, and a northern system, the Monsoon Drift, whose currents are directly related to the seasonal shift of monsoon winds. (Encylopedia.com, 2003) The southwest monsoon in the summer results in southwest-to-northeast winds and currents, and the northeast monsoon results in the opposite direction of wind and currents (CIA, 2003). Deepwater circulation is controlled primarily by inflows from the Atlantic Ocean, the Red Sea, and Antarctic currents. (Wikipedia, 2003)

Due to the Coriolis force, water in the North Atlantic Ocean circulates in a clockwise direction. In latitudes above 40 degrees north, some east-west oscillation occurs. The surface water currents in the open ocean influence the temperature of the water and the types of species that live in the region. Exhibit H-12 shows the surface currents in the world's oceans.

Exhibit H-12. Surface Currents of the World's Oceans



Source: UCAR, 2001a

Water Quality

Water quality in the open ocean is considered excellent, with high water clarity, low concentrations of suspended matter, dissolved oxygen concentrations at or near saturation, and low concentrations of contaminants such as trace metals and hydrocarbons.

H.11 Atmosphere

The Atmosphere envelops all areas of the Earth and consists of the four principal layers of the Earth's atmosphere: troposphere, stratosphere, mesosphere, and ionosphere or thermosphere.[14] These layers are characterized by altitude, temperature, structure, density, composition, and degree of ionization – the positive or negative electric charge associated with each layer. Altitude ranges for atmospheric layers are shown in Exhibit 3-20.

Troposphere

The troposphere extends from the Earth's surface to approximately ten kilometers (6.2 miles). It is the turbulent and weather region containing 75 percent of the total mass of the Earth's atmosphere. It is characterized by decreasing temperature with increasing altitude. The major components of the troposphere are N_2 (76.9 percent) and oxygen (20.7 percent). Other components of lesser concentration include water vapor (1.4 percent in the lower atmosphere), argon, CO_2, nitrous oxide, hydrogen (H_2), xenon, and ozone.

The troposphere is composed of two sub-layers: the atmospheric boundary layer (lower troposphere) and the free troposphere. The altitude of the atmospheric boundary layer is a function of surface roughness and temperature gradient and extends from the surface of the Earth to approximately two kilometers (1.2 miles). The altitude of the free troposphere is a function of time and location, and ranges from approximately two to 10 kilometers (1.2 to 6.2 miles) above the Earth's surface. Clouds and gases in the free troposphere regulate incoming and outgoing radiation, which affects the thermal heat balance of the Earth's surface.

Air pollutants frequently move through the atmospheric boundary layer and into the free troposphere, where they are subject to photochemical oxidation and chemical reactions within cloud droplets and return through precipitation to the atmospheric boundary layer or the Earth's surface.

Certain emissions or toxic contaminants, from both human and natural activities, can cause acute health exposure, degrade ambient air quality, can form acid rain that is deposited on Earth, or can travel to the upper atmosphere to contribute to global warming and ozone depletion. Approximately ten percent of the Earth's ozone is in the troposphere. Ozone at the Earth's surface is of great concern because it can directly damage life, including crop production, forest growth, and human health. Ozone is also a key ingredient for smog production.

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[14] Most resource areas do not apply to the Atmosphere. Therefore, the affected environment discussion includes only Air Quality, Airspace, Biological Resources, and Transportation.

Stratosphere

The stratosphere is located approximately 10 to 50 kilometers (6.2 to 31 miles) above the Earth's surface. Unlike the troposphere, the stratosphere is characterized by higher temperatures at the higher altitudes. It is the main region of ozone production in the atmosphere. Stratospheric ozone absorbs ultraviolet solar radiation, which is known to increase rates of skin cancer in humans and can be harmful to plant and animal life. Most atmospheric ozone (90 percent) is found in the stratosphere. The highest ozone concentrations are found in the lower stratosphere.

The concentration of ozone results from a dynamic balance between the ozone transported by stratospheric circulation and ozone destruction and production by chemical means. The dynamic nature of this balance means that ozone can vary on many timescales. Variations on timescales of up to 11 years have been observed, correlating with the solar cycle. Annual variations in the total ozone column can be as much as one percent, while day-to-day changes can be greater than ten percent. Causes of temporal ozone variations include changes in ozone transport, changes in ozone chemistry, or a coupling of these processes. Although the tropical latitudes have fairly constant year-round ozone levels, temperate altitudes exhibit strong seasonal ozone variations with a maximum peaking in March/April and a minimum in October/November in the northern hemisphere, and the reverse variation in the southern hemisphere. Variations in ozone concentrations may be solar-related or caused by other natural or man-induced variations in the chemistry of the stratosphere.

Ozone is continually created and destroyed by naturally occurring photochemical processes, and its concentration fluctuates seasonally (25 percent) and annually (one to two percent). Ozone is made up of three oxygen atoms and is generated by the action of sunlight to combine an oxygen molecule with an atom of oxygen. Atomic oxygen is produced by photolysis, or the use of radiant energy to produce chemical changes, of molecules of oxygen, NO_2, or ozone. Ozone can be depleted by compounds that contain various elements, most notably chlorine, fluorine, H_2, and N_2. Aluminum oxide (Al_2O_3) (particulates) and soot also may provide a reaction surface for the destruction of ozone. NO_2 is also important in the stratosphere; it functions as a major catalyst for ozone destruction at those altitudes.

The capability for stratospheric ozone depletion by a particular organo-chlorine compound is basically a consequence of its ability to deliver chlorine to the stratosphere and is primarily a function of its number of chlorine atoms, atmospheric lifetime, and stratospheric reactivity. Ozone depletion potentials have been developed for organo-chlorine compounds. They represent the relative amount of ozone depletion calculated in atmospheric models in comparison to the losses from an equivalent tonnage of CFC-11 set as 1.0.

Concerns about the ozone layer, and in particular the effect of man-made chlorine, led to the Montreal Protocol of 1987. Under the Montreal Protocol, more than 90 nations, including the U.S., agreed to limit future production of ozone-depleting compounds. There are two classes of ozone-depleting compounds. Class I substances include chlorofluorocarbons, carbon tetrachloride, halons, methyl bromide, and methyl chloroform. Class II substances consist of hydrochlorofluorocarbons. In the U.S., the 1990 Clean Air Act Amendments established phase-out schedules that surpassed those established during the Montreal Protocol and subsequent international meetings. The term “phase-out” refers to discontinuation of both production and consumption. Production of Class I substances was phased out by January 1, 1996, with the exception of halons, production of which was phased out on January 1, 1994. Class II substances have a more gradual phase-out schedule, which began in 2000 and extends to approximately 2020. The EPA can issue exceptions to the ban on use of some of these substances for medical, aviation safety, national security, and fire-extinguishing purposes.

EO 13148, Greening the Government Through Leadership in Environmental Management (65 FR 24595, 2000) requires Federal agencies to develop “a plan to phase out the procurement of Class I ozone-depleting substances for all nonexcepted uses by December 31, 2010. Plans should target cost effective reduction of environmental risk by phasing out Class I ozone-depleting substance applications as the equipment using those substances reaches its expected service life. DoD contracts may not include a specification that requires the use of a Class 1 ozone-depleting substance, unless a waiver is granted. An agency may request a waiver, and waiver requests must provide: (1) an explanation of the mission critical use of the chemical; (2) an explanation of the nature of the need for the chemical to protect human health; (3) a description of efforts to identify a less harmful substitute chemical or alternative processes to reduce the release and transfer of the chemical in question; and (4) a description of the off-site transfers of toxic chemicals for treatment directly associated with environmental restoration activities.”

The stratospheric ozone discussed above can be characterized as beneficial to the human environment. This is contrasted to the ozone produced near the surface of the earth formed through chemical reactions between precursor emissions of VOCs and NO_x in the presence of sunlight. High concentrations of ozone at ground level are a major health and environmental concern.

Mesosphere

The mesosphere extends from 50 to 80 kilometers (31 to 53 miles) above the Earth’s surface. The upper boundary of the ozone layer occurs at the base of the mesosphere. The temperature in the mesosphere decreases with altitude and distance from radiation adsorbing ozone molecules. Varied wind speeds and directions also characterize the mesosphere.

Ionosphere/Thermosphere

The ionosphere is the lowest part of the Earth's upper atmosphere and roughly extends from 80 to 1,000 kilometers (50 to 620 miles). In the ionosphere, the temperature rises with altitude due to the molecular adsorption of high-energy solar radiation. The ionosphere is further characterized by its high ion and electron density and is composed of several layers, each with different properties.

The E layer is the lowest layer, occurring between 80 and 140 kilometers (50 and 87 miles), and the dominant ion in the E layer is the NO+ ion. The F1 and F2 layers occur between 140 and 1,000 kilometers (621 miles), and the dominant ion in these layers is O+. The F2 layer always is present, and the highest electron concentration occurs within this layer at about 300 kilometers (186 miles). Above 300 kilometers (186 miles), the electron concentration decreases to a distance equivalent to several Earth radii. At this point, the Earth's magnetic field and the protonosphere (the outermost portion of the ionosphere) become indistinct from the solar wind or space.

The major neutral (non-charged) constituents of the ionosphere are atomic oxygen, N_2 and oxygen, and minor constituents are NO, atomic nitrogen, helium, argon, and CO_2. These neutral constituents are influenced strongly by the motions of plasma, or ionized gas. Though this layer has properties similar to a vacuum (by comparison to the Earth's surface), orbiting satellites still encounter drag forces within it.

The different layers of the ionosphere are important to low frequency radio communications. Radiation from the visible spectrum (e.g., aurora) originates in this region. The ionosphere is influenced by solar radiation, variations in the Earth's magnetic field and the motion of the upper atmosphere. Because of these interactions, the systematic properties of the ionosphere vary greatly with geographic latitude and time (diurnally, seasonally, and over the approximately 11-year solar cycle).

H.11.1 Air Quality

Radiation Balance/Global Climate Change

During the past 150 years, combustion of fossil fuels has resulted in increasing concentrations of atmospheric gases that are believed to influence global climate. Some of the activities associated with the BMDS could involve launches that use rocket fuels derived from fossil fuels. The partial products of combustion (burning) of the rocket fuel (which consists of hydrocarbons) are CO_2 and water. Both liquid and solid fuel propulsion systems emit water vapor and CO_2, either directly from the nozzle or as a result of afterburning in the exhaust fumes.

The temperature of the earth's atmosphere is determined by three factors: the sunlight it receives, the sunlight it reflects, and the infrared radiation absorbed by the atmosphere. The principal absorbers include CO_2, water vapor, nitrous oxide, CFCs, and methane. In general, higher concentrations of these gases produce increased absorption of infrared radiation and warmer temperatures. This phenomenon is commonly referred to as the "greenhouse effect."

H.11.2 Airspace

Exhibit H-13 illustrates the relationship between airspace classifications and atmospheric layers.

Exhibit H-13. Relationship between Airspace Classifications and Atmospheric Layers

Type of Airspace	Altitude (from MSL)	Atmospheric Layer(s)
Controlled	> 5.5 kilometers (3.4 miles)	Troposphere, Stratosphere
Uncontrolled	< 4.4 kilometers (2.7 miles)	Troposphere

H.11.3 Biological Resources

While the atmosphere generally is not considered to contain biological resources, atmospheric conditions have a direct impact on climate, which affects the location and health of biological resources.

H.11.4 Orbital Debris

Orbital debris for the purposes of this PEIS is defined as abandoned man-made objects or components of these objects that are orbiting the Earth in space. The space environment may be defined as any location outside the Earth's atmosphere and is generally considered to begin at an altitude approximately 120 kilometers (76 miles) above the Earth's surface, where the aerodynamic forces of the atmosphere are so thin that the various control surfaces of an aircraft (e.g., rudder, aileron, elevator) no longer function effectively. Space is characterized by a vacuum-like quality, devoid of the evenly distributed gases that make up the Earth's atmosphere. This PEIS analyzes proposed BMDS activities that may take place in space with regard to their potential to impact the human environment. The NEPA definition of the human environment does not, based on its characteristics, include the space environment. However, unlike natural debris like meteoroids that is part of the space environment and sweep through Earth orbital space at an average speed of 20 kilometers per second (12 miles per second), orbital debris remains in Earth orbit creating potential acute and cumulative impacts on satellites and other space objects. This analysis includes the impacts of orbital debris that pose a potential collision hazard to man-made objects such as satellites and spacecraft in orbit. Eventually these orbiting objects lose energy and drop into consecutively lower orbits

until they reenter Earth's atmosphere. Orbital debris has no impact on the human environment unless and until the debris enters the Earth's atmosphere. De-orbiting debris (i.e., debris reentering the atmosphere from orbit) is a potential concern as a course of deposition of small particles into the stratosphere, and as a possible contributor to stratospheric ozone depletion by providing particulate reaction sites.

Orbital debris generally can be classified into four source categories. Operational debris are composed of inactive payloads and objects released during satellite delivery or satellite operations, including lens caps, separation and packing devices, spin-up mechanisms, empty propellant tanks, spent and intact vehicle bodies, payload shrouds, and a few objects thrown away or dropped during manned activities. Fragmentation debris results from either collisions or explosions. Deterioration debris is very small debris particles created by the gradual disintegration of spacecraft surface as a result of exposure to the space environment, including paint flaking and plastic and metal erosion. Solid rocket motor ejecta results from the ejection of thousands of kilograms of Al_2O_3 dust from solid rocket motors into the orbital environment. (DOT, 2001b)

Orbital debris particles can be characterized by size as

- Small – debris particles smaller than 1.02 centimeters (0.4 inch) in diameter,
- Medium – debris particles between 1.02 and 10.2 centimeters (0.4 and four inches) in diameter, and
- Large – debris particles larger than 10.2 centimeters (four inches) in diameter.

Large particles represent five percent of the total population of debris particles. Particles of this size can be tracked and catalogued by the Space Surveillance Network. (U.S. Department of the Air Force, 2000) The major source of orbital debris is explosion/collision-induced satellite breakups. Although the exact cause of most breakups is unknown, it is generally thought to result primarily from inadvertent mixing of hypergolic fuels, overheating of residual propellants or deliberate fragmentation. (U.S. Department of the Air Force, 2000) The interaction among these three classes combined with their long residual times in orbit creates concern that there may be collisions producing additional fragments and causing the total debris population to grow, which may increase the chance of debris reentry into Earth's atmosphere.

The National Research Council (NRC) estimated that there are more than 10,000 objects greater than 10.2 centimeters (four inches) in size in orbit (including the almost 8,0999 tracing by AFSPC), tens of millions between 0.099 and 10.2 centimeters (0.039 and four inches) in size, and a trillion less than 0.099 centimeters (0.0.39 inch) in size. (U.S. Department of the Air Force, 2000)

A 2006 Executive Branch policy directive, National Space Policy, provides guidance for orbital debris: "The United States shall seek to minimize the creation of orbital debris by

government and non-government operations in space in order to preserve the space environment for future generations...Departments and agencies shall continue to follow the United States Government Orbital Debris Mitigation Standard Practices...The Secretaries of Commerce and Transportation, in coordination with the Chairman of the Federal Communications Commission, shall continue to address orbital debris issues through their respective licensing procedures."

Hazards to Space Operations from Orbital Debris

The effects of launch-vehicle-generated orbital debris impacts on other spacecraft depend on the altitude, orbit, velocity, angle of impact, and mass of the debris. Debris particles defined as "small" in size would cause surface pitting and erosion. Over a long period of time, the cumulative effect of individual particles colliding with a satellite may become significant. Medium sized debris would produce significant impact damage that can be serious, depending on system vulnerability and defensive design provisions. Large particles can produce catastrophic damage. Astronauts or cosmonauts engaging in extra-vehicular activities could be vulnerable to the impact of small debris. On average, debris 1 millimeter (0. 04 inch) is capable of perforating current U.S. space suits. (Cour-Palais, 1991, as referenced in Commission on Engineering and Technical Systems, 1995)

Solid rocket motors eject Al_2O_3 dust (typically less than 0.004 inch) into the orbital environment, and may release larger chunks of unburned solid propellant or slag. However, solid rocket motor particles typically either decay very rapidly, probably within a few perigee (lowest point of orbit) passages, or are dispersed by solar radiation pressure. Thus, the operational threat of solid rocket motor dust is probably limited to brief periods of time related to specific mission events. (U.S. Department of the Air Force, 2000)

Orbital debris generated by launch vehicles contributes to the larger problem of pollution in space that includes radio-frequency interference and interference with scientific observations in all parts of the spectrum. For example, emissions at radio frequencies often interfere with radio astronomy observations (Office of Technology Assessment, 1990). Not only can orbital debris interfere with the performance of scientific experiments, but may even accidentally destroy them. (U.S. Department of the Air Force, 2000)

Over a long period of time, the cumulative effect of individual particles colliding with a satellite might become significant because the number of particles in this size range is very large in LEO. Although solid rocket motor ejecta are very small, long-term exposure of payloads to such particles is likely to cause erosion of exterior surfaces, chemical contamination, and may degrade operations of vulnerable components such as optical windows and solar panels. (DOT, 2001b)

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APPENDIX I
CUMULATIVE IMPACTS

CUMULATIVE IMPACTS

Background

Cumulative impacts are defined as the sum of the incremental impacts of a proposed action when added to the impacts of the activities of other past, present, and reasonably foreseeable future actions, regardless of the agency or person who undertakes them. As discussed in Section 4.2.3, the proposed action is worldwide in its scope and potential application; therefore, similar actions, which are worldwide in scope, have been considered for this analysis.

Worldwide commercial and government launch programs were determined to be activities of international scope that might reasonably be considered along with projected BMDS launches for cumulative impacts in this PEIS. Launches can contribute to cumulative impacts including ozone depletion, global warming, and orbital debris. In the stratosphere, cumulative impacts of worldwide launches could affect global warming and depletion of the stratospheric ozone layer because combustion products emitted during launch activities can play a role in these atmospheric conditions.

In the stratosphere, cumulative impacts of worldwide launches could affect global warming and depletion of the stratospheric ozone layer because launch emissions and their subsequent exhaust and atmospheric reaction products could play a role in causing or exacerbating these conditions. The cumulative impact, however, on global warming from launches would be insignificant when compared to other industrial sources of greenhouse gases and ozone-depleting substances. Further, the cumulative impact on stratospheric ozone depletion from launches would be far below and indistinguishable from the effects attributable to other natural and man-made causes. Ongoing research in this area indicates that ozone depletion from launch exhaust is limited spatially and temporally, and that these reactions do not have a globally significant impact on stratospheric chemistry. (Ross et al, 1997 as referenced in DOT, 2001b)

There has been extensive research on the potentially harmful effects of large solid propellant exhaust on global ozone depletion supported by the Air Force and NASA. These studies are generally based on a high launch rate, which allows for evaluation of large chlorine loads to the stratosphere. One such study by the World Meteorological Organization (1994 as referenced in DOT, 2001b) examined the effects of 10 launches annually of each of the following vehicles: Space Shuttle, Titan IV, and Ariane 5, which release 62, 29, and 52 metric tons (68, 32, and 57 tons) of atomic chlorine (Cl) per launch, respectively, directly into the stratosphere. A total of 1,424 metric tons (1,570 tons) of Cl deposited in the stratosphere each year from these launches corresponds to only 0.064% of the

1994 total stratospheric burden of chlorine from industrial sources. Analyses in the Rocket Impact on Stratospheric Ozone study (Ross, 1998 as referenced in DOT, 2001b) have confirmed that ozone loss occurs in the plume wakes of large solid propellant boosters (e.g., Titan IV and Space Shuttle), but the amount and duration of the loss appears to be temporary and limited.

This appendix presents the methodology used to estimate BMDS and other worldwide launch emission loads to the stratosphere as discussed in Section 4.2.3. These launch emission loads were then used to determine the cumulative impact on global warming from CO and CO_2 emissions and the cumulative impact on stratospheric ozone depletion from chlorine emissions.

Major inputs needed to determine the emission loads to the stratosphere and troposphere were

- Booster residence time, or the amount of time it takes the booster to travel through each layer of the atmosphere,
- Projected number of BMDS and worldwide launches, and
- Emission weight fractions, or the amounts of each emission (such as hydrogen chloride [HCl] and Al_2O_3) from combustion of the propellant.

Booster Residence Time

The booster residence time is determined based on the amount of time it takes the booster to travel through each layer of the atmosphere. The four layers of the Earth's atmosphere are the troposphere, extending from the surface to 10 kilometers (six miles); stratosphere, extending 10 to 50 kilometers (six to 31 miles); mesosphere, extending 50 to 80 kilometers (31 to 50 miles); and ionosphere, extending 80 to 1,000 kilometers (50 to 621 miles). See Exhibit 3-20 in Section 3.2.11. The residence time is used as the basis for determining the amount of propellant expended and thereby the amount of combustion products emitted in each layer of the atmosphere. The time a booster spends in an atmospheric layer is roughly correlated with the size of the booster. A smaller booster moves faster and therefore, spends less time in each atmospheric layer. The atmospheric interceptor technology (*ait*) booster is representative of boosters that would be part of the BMDS. The *ait* has been shown to spend approximately 25 seconds in both the troposphere and stratosphere. This PEIS provides a conservative analysis, which assumes that all boosters would spend approximately 60 seconds in both the troposphere and stratosphere. This residence time is sufficiently conservative to account for emissions from BMDS launches and from other worldwide launches of larger boosters. Because the residence time for boosters traveling through the troposphere and stratosphere was the same, it was assumed that the type and quantity of combustion product emissions would be the

same in both the troposphere and stratosphere. (Department of Air Force, 1990 as referenced in DOT, 2001b)

Projected Number of BMDS and Worldwide Launches

The number of BMDS projected launches was estimated at 515[15] during the years 2004 to 2014. Worldwide projected launches, which include 77 United States (U.S.) commercial launches (FAA Office of Commercial Space Transportation [AST], 2003); 99 U.S. government launches (NASA, 2003a; NASA, 2003b; NASA, 2003c); 183 foreign commercial launches (COMSTAC, 2003); and 476 foreign government launches (NASA, 2004; Gunter's Space Page, 2004; Spaceflight Now, 2004a; Spaceflight Now, 2004b), were estimated to total 835 launches during the years 2004 and 2014. U.S. military launches were either captured under BMDS launches or under U.S. government launches (e.g., NASA launching a military satellite).

Launches were categorized by classes of boosters using a method developed in the PEIS for Licensing Launches. (DOT, 2001b) Boosters were classified into ranges based on the size of the propulsion system, specifically, the amount of propellant consumed in both the troposphere and the stratosphere. The ranges are

- Low (up to 75,000 kilograms [165,347 pounds] of propellant);
- Medium (75,000-100,000 kilograms [165,347-220,462 pounds] of propellant);
- Intermediate (100,000-200,000 kilograms [220,462-440,925 pounds] of propellant); and
- High (greater than 200,000 kilograms [440,925 pounds] of propellant).

Exhibit I-1 shows the number of BMDS launches and worldwide launches.

[15] Projected number of launches based on internal proposed test events.

Exhibit I-1. Projected Number of BMDS and Worldwide Launches (2004-2014) by Amount of Propellant Consumed in Troposphere and Stratosphere

Launch Type	Projected Number of Launches	Booster Classification By Amount of Propellant Consumed in the Stratosphere	Number of Boosters per Range of Propellant Used
BMDS Launches	515	Low	515
		Medium	0
		Intermediate	0
		High	0
U.S. Commercial[a]	77	Low	11
		Medium	11
		Intermediate	22
		High	33
U.S. Government[b]	99	Low	11
		Medium	44
		Intermediate	11
		High	33
Foreign Commercial[c]	183	Low	39
		Medium	17
		Intermediate	90
		High	37
Foreign Government[d]	476	Low	38
		Medium	8
		Intermediate	32
		High	398

Sources:
[a]AST, 2003
[b]NASA, 2003a; NASA, 2003b; and NASA, 2003c
[c]COMSTAC, 2003
[d]NASA, 2004;Gunter's Space Page, 2004; Spaceflight Now, 2004a and Spaceflight Now, 2004b

BMDS and worldwide launches use various types of propellants. Exhibit I-2 shows the number of flights through the stratosphere of boosters by launch and propellant type.

Exhibit I-2. Projected Number of Flights Through Stratosphere by Launch and Propellant Type

Launch Type	Booster Classification	Propellant Type	Number of Flights Through Stratosphere
BMDS Launches	Low	Solid	413
		Liquid Hypergolic	68
		Liquid Oxygen (LOX)-Rocket Propellant 1 (RP1)	34
	Medium	-	-
	Intermediate	-	-
	High	-	-
U.S. Commercial Launches	Low	Solid	11
	Medium	Solid	11
	Intermediate	LOX-RP1/Solid	16
		Hybrid	6
	High	Solid/LOX-LH_2 [16]	8
		LOX-RP1	17
		Solid/LOX-RP1	8
U.S. Government	Low	Solid	10
		Hypergolic	1
	Medium	Solid	4
		Solid/LOX-RP1	18
		Solid/LOX-LH_2	11
		LOX-RP1	11
	Intermediate	Solid	2
		LOX-RP1	6
		LOX-RP1	1
		LOX-LH_2	2
	High	Solid/LOX-LH_2	24
		LOX-RP1	2
		Solid/Hypergolic	5
		LOX-LH_2	2
Foreign Commercial	Low	Solid	14
		Hypergolic	25
	Medium	Solid	5
		Hypergolic	9
		Solid/Hypergolic	3

[16] LH_2 is liquefied hydrogen (H_2).

Exhibit I-2. Projected Number of Flights Through Stratosphere by Launch and Propellant Type

Launch Type	Booster Classification	Propellant Type	Number of Flights Through Stratosphere
	Intermediate	Hypergolic	36
		Solid/LOX-LH_2	9
		LOX-RP1	45
	High	Hypergolic	22
		LOX-RP1	9
		Solid	6
Foreign Government	Low	Solid	13
		Hypergolic	25
	Medium	Solid	2
		Hypergolic	4
		Solid/Hypergolic	1
	Intermediate	Hypergolic	13
		Solid/LOX-LH_2	4
		LOX-RP1	16
	High	Hypergolic	239
		LOX-RP1	100
		Solid	59

Emission Weight Fraction

The emissions from booster launches depend on the propellants used. BMDS boosters would use three primary propellant combinations: solid, LOX-RP1, and liquid hypergolic. Pre-fueled liquid propellant boosters would use liquid hypergolic propellants and non-pre-fueled liquid propellant boosters would use LOX-RP1 propellants. Even though the same emissions are produced by boosters using the same propellants, the amounts of emissions produced vary. The amount of each combustion product can be calculated using weight fractions. The weight fractions of combustion products of concern for propellants used in BMDS launches are listed in Exhibit I-3. (DOT, 2001b) Note that because some of the combustion products react with oxygen in the exhaust plume immediately upon being emitted, forming other emission products (e.g., one molecule of N_2 reacts with oxygen to generate two molecules of NO_X) the sum of the weight fractions in Exhibit I-3 may be greater than one.

Exhibit I-3. Weight Fraction of Propellant Emissions for BMDS Launches

Propellant	HCl	Al_2O_3	CO_2	H_2O*	H_2	OH**	N_2	Cl	NO_X	CO
Solid	0.21	0.38	0.46	0.27	-	-	-	0.0028	0.27	-
LOX-RP1	-	-	0.931	0.34	-	0.035	-	-	-	-
Liquid Hypergolic	-	-	0.22	0.35	-	-	-	-	1.36	-

*H2O is water.
**OH is the hydroxyl radical.

Worldwide launches may use propellant types not used or proposed to be used by the MDA. Therefore, weight fractions for other types of propellants used in worldwide launches were developed to support this analysis. The weight fractions for propellants used in worldwide launches are listed in Exhibit I-4. (DOT, 2001b) For both BMDS and worldwide launches, CO will react almost completely with oxygen in the air to form CO_2 in the high temperatures of the exhaust plume in the troposphere and stratosphere. Likewise, H_2 and N_2 in the exhaust plume will react almost completely with oxygen to form H_2O and NO_X, respectively. Consequently, the weight fractions in Exhibits I-3 and I-4 are based on the assumptions that the entire amount of CO emitted reacts to form CO_2, all H_2 forms H_2O, and all N_2 forms NO_X. (DOT, 2001b) As noted above the sum of the weight fractions in Exhibit I-4 may be greater than one.

Exhibit I-4. Weight Fraction of Propellant Emissions for Worldwide Launches

Propellant	HCl	Al_2O_3	CO_2	H_2O	H_2	OH	N_2	Cl	NO_X	CO
Solid	0.21	0.38	0.46	0.27	-	-	-	0.0028	0.27	-
LOX-RP1	-	-	0.931	0.34	-	0.035	-	-	-	-
Hybrid	-	-	0.931	0.34	-	0.035	-	-	-	-
Liquid Hypergolic	-	-	0.22	0.35	-	-	-	-	1.36	-
Solid/LOX-RP1	0.105	0.185	0.69	0.31	-	0.018	-	0.0014	0.13	-
Solid/LOX-LH_2	0.105	0.19	0.23	0.635	-	-	-	0.0014	0.135	-
Solid/ Hypergolic	0.105	0.19	0.34	0.31	-	-	-	0.0014	0.815	-

Calculation of Emission Loads for Projected BMDS Launches

As shown in Exhibit I-2, of the 515 projected BMDS launches, it was estimated that 413 of these launches would be solid propellant boosters; 34 would be non-pre-fueled liquid propellant boosters; and 68 would be pre-fueled liquid propellant

boosters. All of the BMDS launches fell in the "Low" booster classification range. However, within the Low range there are many types and sizes of solid propellant boosters. Therefore, these boosters were further classified (as shown in Exhibit I-5) based on the quantity of propellant consumed in the stratosphere to obtain a more accurate representation of emission loads to the stratosphere from proposed BMDS launches.

Exhibit I-5. Further Classification of Solid-Propellant BMDS Launches during 2004-2014 Based on Propellant Consumed in Stratosphere

Booster Classification	Maximum Propellant Quantity Consumed in Stratosphere in kilograms (pounds)[a]	Percent of BMDS Launches in Each Booster Classification	Number of Booster Flights Through Stratosphere
Low (A)	Up to 500 (1,102)	13%	54
Low (B)	500-1,000 (1,102-2,205)	10%	41
Low (C)	1,000-5,000 (2,205-11,023)	10%	41
Low (D)	5,000-8,000 (11,023-17,637)	22%	91
Low (E)	8,000-15,000 (17,637-33,069)	29%	120
Low (F)	15,000-30,000 (33,069-66,139)	3%	12
Low (G)	30,000-60,000 (66,139-132,277)	13%	54

[a]Amount of propellant quantity consumed in the stratosphere was based on review of existing booster propellant information and booster residence time

Exhibit I-6 presents the estimated emissions loads to the stratosphere from BMDS launches from 2004 to 2014. Exhibit I-6 includes

- Propellant type used during flight through stratosphere;
- Number of booster flights through the stratosphere; and
- Maximum quantity of propellant consumed in the stratosphere, which is determined based on the booster residence time in the stratosphere (60 seconds assumed).

Exhibit I-6. Estimated Emission Loads to Stratosphere from Proposed BMDS Launches from 2004-2014[17]

Booster Classification*	Propellant Type	Number of Flights Through Stratosphere	Maximum Propellant Quantity Consumed in Stratosphere in kilograms (pounds)	Emission Loads in kilograms x 10^3 (pounds x 10^3)**					
				Al_2O_3	Cl	CO_2	H_2O	HCl	NO_X
Low (A)	Solid	54	500 (1,102)	10 (23)	0.08 (0.2)	12 (27)	7 (16)	6 (13)	7 (16)
Low (B)		41	1,000 (2,205)	16 (34)	0.1 (0.3)	19 (42)	11 (24)	9 (19)	11 (24)
Low (C)		41	5,000 (11,023)	78 (172)	0.6 (1)	94 (208)	55 (122)	43 (95)	55 (122)
Low (D)		91	8,000 (17,637)	277 (610)	2 (4)	335 (738)	197 (433)	153 (337)	197 (433)
Low (E)		120	15,000 (33,069)	684 (1508)	5 (11)	828 (1825)	486 (1071)	378 (833)	486 (1071)
Low (F)		12	30,000 (66,139)	137 (302)	1 (2)	166 (365)	97 (214)	76 (167)	97 (214)
Low (G)		54	60,000 (132,277)	1,231 (2,714)	9 (20)	1,490 (3,286)	875 (1,929)	680 (1,500)	875 (1,929)
Low	Liquid Hypergolic	68	1,000 (2,205)	-	-	15 (33)	24 (52)	-	92 (204)
Low	LOX-RP1	34	5,000 (11,023)	-	-	158 (349)	58 (127)	-	-
Total in kilograms x 10^3 (pounds x 10^3)				2,432 (5,362)	18 (39)	3,118 (6,873)	1,810 (3,990)	1,344 (2,963)	1,821 (4,014)
Total in metric tons (tons)				2,432 (2,680)	18 (20)	3,118 (3,436)	1,810 (1,994)	1,344 (1,481)	1,821 (2,006)

*Refer to Exhibit I-2 for description of Booster Classification
** Calculations subject to rounding

[17] The load to the troposphere would be the same as the load to the stratosphere because the residence time is the same (60 seconds) and the propellant type used is the same.

The number of flights through the stratosphere was multiplied by the maximum quantity of propellant consumed in the stratosphere to find the total amount of propellant consumed in the stratosphere for projected BMDS launches. The total amount of propellant was then multiplied by the appropriate weight fraction based on the type of propellant used (listed in Exhibit I-3 for BMDS launches).

Calculation of Emissions Loads for Worldwide Launches

Exhibits I-7 and I-8 present the estimated emission loads to the stratosphere from U.S. commercial and government launches from 2004 to 2014, respectively. Within each booster classification (Low, Medium, Intermediate, and High) the percent of rockets using various propellants was calculated based on previous studies. (DOT, 2001b) Representative vehicles were used for each propellant within each vehicle classification to determine emission loads. Propellant quantities and types for U.S. commercial and government vehicles in the Low propellant use vehicle classification were based on quantities currently used for commercial launches. Propellant quantities and types for U.S. commercial and government vehicles in the High propellant use vehicle classification were based on the Titan IV and Space Shuttle. (Isakowitz, 1999 as referenced in DOT, 2001b)

Exhibits I-7 and I-8 also include the maximum quantity of propellant consumed in the stratosphere, which was determined based on the booster's residence time. The number of flights was multiplied by the maximum quantity of propellant consumed to determine the total amount of propellant consumed in the stratosphere for projected U.S. commercial and government launches. The total amount of propellant was then multiplied by the appropriate weight fraction based on the propellant used (listed in Exhibit I-4 for worldwide launches).

Exhibits I-9 and I-10 present the emission loads to the stratosphere from foreign commercial and government launches from 2004 to 2014, respectively. Within each vehicle classification (Low, Medium, Intermediate, and High) the percent of vehicles using various propellants was calculated based on previous studies. (DOT, 2001b) Representative boosters were used for each propellant within each booster classification to determine emission loads. Specific international vehicles that are used currently or are under development were examined. These include the Zenit (Russia), Proton (Russia), Ariane IV and V (European Space Agency), Long March (China), H2 (Japan), GSLV (India), PSLV (India), and M-V (Japan). The propellant quantities and types used in various layers of the Earth's atmosphere were developed from previous studies. (Isakowitz, 1999 as referenced in DOT, 2001b)

Exhibits I-9 and I-10 also include the maximum quantity of propellant consumed in the stratosphere, which was determined based on the booster's residence time in

the stratosphere. The number of flights was multiplied by the maximum quantity of propellant consumed to determine the total amount of propellant consumed in the stratosphere for projected foreign commercial and government launches. This total amount of propellant was then multiplied by the appropriate weight fraction based on the propellant used (listed in Exhibit I-4 for worldwide launches).

Exhibit I-7. Estimated Emission Loads to Stratosphere from U.S. Commercial Launches from 2004-2014

Booster Classification	Percent Boosters using Various Propellant Types During Flight through Stratosphere	Example of Booster Type	Number of Flights Through Stratosphere	Maximum Propellant Quantity Consumed in Stratosphere in kilograms (pounds)	Emission Loads in kilograms x 10^3 (pounds x 10^3)*					
					Al_2O_3	Cl	CO_2	H_2O	HCl	NO_X
Low	100% Solid	Taurus/ Athena	11	30,000 (66,139)	125 (276)	0.9 (2)	152 (335)	89 (196)	69 (153)	89 (196)
Medium	100% LOX-RP1/Solid	Delta 2	11	75,000 (165,347)	153 (336)	1 (3)	569 (1,255)	256 (564)	87 (191)	107 (236)
Intermediate	75% LOX-RP1/Solid	Delta 3, Atlas IIAS	16	100,000 (220,462)	296 (653)	2 (5)	1,104 (2,434)	496 (1,093)	168 (370)	208 (459)
	25% Hybrid	To be developed	6	100,000 (220,462)	-	-	559 (1,231)	204 (450)	-	-
High	25% Solid/LOX-LH2	Delta 4H Commercial	8	110,000 (242,508)	167 (369)	1 (3)	202 (446)	559 (1,232)	92 (204)	119 (262)
	50% LOX-RP1	Zenit Sea Launch/BA-2	17	250,000 (551,156)	-	-	3,957 (8,723)	1,445 (3,186)	-	-
	25% Solid/LOX-RP1	Atlas 5 Commercial	8	250,000 (551,156)	370 (816)	3 (6)	1,380 (3,042)	620 (1,367)	210 (463)	260 (573)
Total in kilograms x 10^3 (pounds x 10^3)					1,111 (2,450)	8 (19)	7,923 (17,466)	3,669 (8,088)	626 (1,381)	783 (1,726)
Total in metric tons (tons)					1,111 (1,225)	8 (9)	7,923 (8,734)	3,669 (4,044)	626 (690)	783 (863)

* Calculations subject to rounding

Exhibit I-8. Estimated Emission Loads to Stratosphere from U.S. Government Launches from 2004-2014

Booster Classification	Percent Boosters using Various Propellant Types During Flight through Stratosphere	Example of Booster Type	Number of Flights Through Stratosphere	Maximum Propellant Quantity Consumed in Stratosphere in kilograms (pounds)	Emission Loads in kilograms x 10^3 (pounds x 10^3)*					
					Al_2O_3	Cl	CO_2	H_2O	HCl	NO_X
Low	90% Solid	Pegasus/ Taurus	10	30,000 (66,139)	114 (251)	0.8 (2)	138 (304)	81 (179)	63 (139)	81 (179)
	10% Hypergolic	Titan 2	1	50,000 (110,231)	-	-	11 (24)	18 (39)	-	68 (150)
Medium	10% Solid	Medium Vehicle	4	75,000 (165,347)	114 (251)	0.8 (2)	138 (304)	81 (179)	63 (139)	81 (179)
	40% Solid/LOX-RP1	Delta 2	18	75,000 (165,347)	250 (551)	2 (4)	932 (2054)	419 (923)	142 (313)	176 (387)
	25% Solid/LOX-LH_2	Delta 4 Medium	11	75,000 (165,347)	157 (346)	1 (3)	190 (418)	524 (1,155)	87 (191)	111 (246)
	25% LOX-RP1	Atlas 5 Medium	11	75,000 (165,347)	-	-	768 (1,693)	281 (618)	-	-
Intermediate	20% Solid	Intermediate Vehicle	2	100,000 (220,462)	76 (168)	0.6 (1)	92 (203)	54 (119)	42 (93)	54 (119)
	55% Solid/LOX-RP1	Atlas 2/ Delta 3	6	100,000 (220,462)	111 (245)	0.8 (2)	414 (913)	186 (410)	63 (139)	78 (172)
	5% LOX-RP1	Atlas 3/ Atlas V Intermediate	1	150,000 (330,693)	-	-	140 (308)	51 (112)	-	-
	20% Solid/LOX-LH_2	Delta 4 Intermediate	2	150,000 (330,693)	57 (126)	0.4 (1)	69 (152)	191 (420)	32 (69)	41 (89)
High	75% Solid/LOX-LH_2	Space Shuttle	24	586,000 (1,291,909)	2,672 (5,891)	20 (43)	3,235 (7,131)	8,931 (19,688)	1,477 (3,256)	1,899 (4,186)
	5% LOX-RP1	Atlas 5 Government	2	400,000 (881,849)	-	-	745 (1642)	272 (600)	-	-
	15% Solid/Hypergolic	Titan 4b	5	315,000 (694,456)	299 (660)	2 (5)	536 (1,181)	488 (1,076)	165 (365)	1,284 (2,830)
	5% LOX-LH_2	Delta 4 Government	2	205,000 (451,947)	-	-	-	410 (904)	-	-
Total in kilograms x 10^3 (pounds x 10^3)					3,850 (8,489)	28 (63)	7,408 (16,327)	11,987 (26,422)	2,134 (4,704)	3,873 (8,537)
Total in metric tons (tons)					3,850 (4,244)	28 (31)	7,408 (8,166)	11,987 (13,213)	2,134 (2,352)	3,873 (4,269)

*Calculations subject to rounding

Exhibit I-9. Estimated Emission Loads to Stratosphere from Foreign Commercial Launches from 2040-2014

Booster Classification	Percent Boosters using Various Propellant Types During Flight through Stratosphere	Example of Booster Type	Number of Flights Through Stratosphere	Maximum Propellant Quantity Consumed in Stratosphere in kilograms (pounds)	Emission Loads in kilograms x 10^3 (pounds x 10^3)*					
					Al_2O_3	Cl	CO_2	H_2O	HCl	NO_X
Low	35% Solid	Leolink/ Shavit/M5	14	40,000 (88,185)	213 (469)	2 (3)	258 (568)	151 (333)	118 (259)	151 (333)
	65% Hypergolic	Kosmos Rokot	25	40,000 (88,185)	-	-	220 (485)	350 (772)	-	1,360 (2,998)
Medium	30% Solid	PSLV, VLS	5	100,000 (220,462)	190 (419)	1 (3)	230 (507)	135 (298)	105 (231)	135 (298)
	55% Hypergolic	Tsyklon/ Long March 2c	9	70,000 (154,324)	-	-	139 (306)	221 (486)	-	857 (1,889)
	15% Solid/Hypergolic	GSLV	3	100,000 (220,462)	57 (126)	0.4 (1)	102 (225)	93 (205)	32 (69)	245 (539)
Intermediate	40% Hypergolic	Long March 3b/Ariane 4	36	100,000 (220,462)	-	-	792 (1,746)	1,260 (2,778)	-	4,896 (10,794)
	10% Solid/LOX-LH_2	H-2A	9	85,000 (187,393)	145 (320)	1 (2)	176 (388)	486 (1,071)	80 (177)	103 (228)
	50% LOX-RP1	Soyuz	45	100,000 (220,462)	-	-	4,190 (9,236)	1,530 (3,373)	-	-
High	60% Hypergolic	Proton	22	210,000 (462,971)	-	-	1,016 (2,241)	1,617 (3,565)	-	6,283 (13,852)
	25% LOX-RP1	Zenit	9	140,000 (308,647)	-	-	1,173 (2,586)	428 (944)	-	-
	15% Solid	Ariane 5	6	237,000 (522496)	540 (1,191)	4 (9)	654 (1,442)	384 (846)	299 (658)	384 (846)
Total in kilograms x 10^3 (pounds x 10^3)					1,145 (2,525)	8 (18)	8,950 (19,730)	6,655 (14,671)	634 (1,394)	14,414 (31,777)
Total in metric tons (tons)					1,145 (1,262)	8 (9)	8,950 (9,866)	6,655 (7,336)	634 (699)	14,414 (15,889)

*Calculations subject to rounding

Exhibit I-10. Estimated Emission Loads to Stratosphere from Foreign Government Launches from 2004-2014

Booster Classification	Percent Boosters using Various Propellant Types During Flight through Stratosphere	Example of Booster Type	Number of Flights Through Stratosphere	Maximum Propellant Quantity Consumed in Stratosphere in kilograms (pounds)	Emission Loads in kilograms x 10^3 (pounds x 10^3)*					
					Al_2O_3	Cl	CO_2	H_2O	HCl	NO_X
Low	35% Solid	Leolink/ Shavit/M5	13	40,000 (88,185)	198 (436)	1 (3)	239 (527)	140 (310)	109 (241)	140 (310)
	65% Hypergolic	Kosmos Rokot	25	40,000 (88,185)	-	-	220 (485)	350 (772)	-	1,360 (2,998)
Medium	30% Solid	PSLV, VLS	2	100,000 (220,462)	76 (168)	0.6 (1)	92 (203)	54 (119)	42 (93)	54 (119)
	55% Hypergolic	Tsyklon/Long March 2c	4	70,000 (154,324)	-	-	62 (136)	98 (216)	-	381 (840)
	15% Solid/Hypergolic	GSLV	1	100,000 (220,462)	19 (42)	0.1 (0.3)	34 (75)	31 (68)	11 (23)	82 (180)
Intermediate	40% Hypergolic	Long March 3b/Ariane 4	13	100,000 (220,462)	-	-	286 (631)	455 (1003)	-	1,768 (3,898)
	10% Solid/LOX-LH2	H-2A	4	85,000 (187,393)	65 (142)	0.5 (1)	78 (172)	216 (476)	36 (79)	46 (101)
	50% LOX-RP1	Soyuz	16	100,000 (220,462)	-	-	1,490 (3,284)	544 (1,199)	-	-
High	60% Hypergolic	Proton	239	210,000 (462,971)	-	-	11,042 (24,343)	17,567 (38,727)	-	68,258 (150,482)
	25% LOX-RP1	Zenit	100	140,000 (308,647)	-	-	13,034 (28,735)	4,760 (10,494)	-	-
	15% Solid	Ariane 5	59	237,000 (522,496)	5,314 (11,714)	39 (86)	6,432 (14,180)	3,775 (8,323)	2,936 (6,474)	3,775 (8,323)
Total in kilograms x 10^3 (pounds x 10^3)					5,672 (12,502)	41 (91)	33,009 (72,771)	27,990 (61,707)	3,134 (6,910)	75,864 (167,251)
Total in metric tons (tons)					5,672 (6,252)	41 (45)	33,009 (36,386)	27,990 (30,854)	3,134 (3,455)	75,864 (83,626)
*Calculations subject to rounding										

APPENDIX J
GLOSSARY

GLOSSARY

A-weighted decibels (dBA) – Unit of measurement representing the sound level which is frequency-weighted according to a prescribed frequency response established by the American National Standards Institute (1983) and accounts for the response of the human ear.

Active Sensor – A sensor that illuminates a target, producing return-secondary radiation for tracking and/or identifying the target. An example is radar.

Air Quality – A resource area determined by the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions.

Air Quality Control Region – A contiguous geographic area designated by the Federal government in which communities share a common air pollution status.

Air Route Traffic Control Center (ARTCC) – A facility established to provide air traffic control services to aircraft operating on IFR flight plans within controlled airspace and principally during the en route phase of flight. When equipment capabilities and controller workload permit, certain advisory/assistance services may be provided to aircraft operating under VFR.

Air Traffic Control – A service operated by appropriate authority to promote the safe, orderly, and expeditious flow of air traffic.

Airspace – The space lying above a nation and coming under its jurisdiction.

American National Standards Institute (ANSI) – An organization which fosters the creation of consensus standards developed by representatives of industry, scientific communities, physicians, government agencies, and the public.

Apogee – The point in an object's orbit of the Earth where it is farthest from the Earth's surface.

Aquifer – The water-bearing portion of subsurface earth material that yields or is capable of yielding useful quantities of water to wells.

Atmosphere – An environment that includes the atmosphere enveloping all areas of the Earth. It consists of four principle layers: troposphere, stratosphere, mesosphere, and ionosphere (or thermosphere).

Atmospheric Dispersion – The process of air pollutants being distributed into the atmosphere. This occurs by wind carrying pollutants away from their source and by turbulent-air motion resulting from solar heating of the Earth's surface and air movement over rough terrain and surfaces.

Atmospheric drag – Refers to the collisions with air particles at high altitudes that slowly act to circularize and reduce the speed of a spacecraft's orbit, which causes it to drop to lower altitudes.

Attainment Area – An air quality control region that has been designated by the U.S. EPA and the appropriate state air quality agency as having ambient air quality levels as good as or better than the standards set forth by the NAAQS, as defined in the Clean Air Act. A single geographic area may have acceptable levels of one criteria air pollutant, but unacceptable levels of another; thus, an area can be in attainment and non-attainment status simultaneously.

Azimuth – The horizontal direction from one point on the earth to another, measured clockwise in degrees (0-360) from a north or south reference line.

Background Noise – The total acoustical and electrical noise from all sources in a measurement system that may interfere with the production, transmission, time averaging, measurement, or recording of an acoustical signal.

Ballistic Missile – Any missile that does not rely upon aerodynamic surfaces to produce lift and consequently follows a ballistic trajectory when thrust is terminated.

Ballistic Missile Defense System (BMDS) – An integrated system that employs layered defenses to intercept missiles during their boost, midcourse, and terminal flight phases.

Benchmark Dose – A dose that produces a predetermined change in response rate of an adverse effect (called the benchmark response) compared to background.

Bioaccumulation – The process by which chemical contaminants become more concentrated in the tissues of organisms as they pass higher up the food chain.

Biological Resources – A collective term for native or naturalized vegetation, wildlife, and the habitats in which they occur.

Biome – A major type of natural vegetation that occurs wherever a particular set of climatic and soil conditions prevail, but that may contain different taxa in different regions.

Biotransformation – Any chemical conversion of substances that is mediated by living organisms or biological enzymes.

Blocks – A biennial increment of the BMDS that provides an integrated set of capabilities, which has been rigorously tested as part of the BMDS Test-bed and assessed to adequately characterize its military utility. Once tested, elements and components are available for limited procurement, transition to production, or for emergency deployment as directed. These "off ramps" may occur at any time during the Block Cycle to support timely execution of these transition or deployment decisions.

The configuration for each Block is drawn from the following sources:

- The prior BMDS Block;
- BMDS elements, components, technologies, and concepts;
- BMDS Battle Management, Command, Control, and Communications (BMC2/C) specifications and products;
- Externally managed systems, elements, or technologies (e.g., DSP, Global Command and Control System, MILSTAR, etc).

Each successive Block provides increasing levels of capability to counter ballistic missiles of all ranges and complexity.

Boost Phase – The first phase of a ballistic missile trajectory during which it is being powered by its engines. During this phase, which usually lasts 3 to 5 minutes for an intercontinental ballistic missile, the missile reaches an altitude of about 200 kilometers (124 miles) whereupon powered flight ends and the missile begins to dispense its reentry vehicles.

Booster – An auxiliary or initial propulsion system that travels with a missile or aircraft and that may not separate from the parent craft when its impulse has been delivered; may consist of one or more units.

Broad Ocean Area (BOA) – An environment that includes the Pacific, Atlantic, and Indian Oceans, and is the area outside of the Exclusive Economic Zone, which extends 322 kilometers (200 miles) off shore.

Carbon Monoxide (CO) – A colorless, odorless, poisonous gas produced by incomplete fossil-fuel combustion; one of the six pollutants for which there is a NAAQS (see Criteria Pollutant).

Chemical Oxygen Iodine Laser (COIL) – A laser in which chemical action is used to produce the laser energy.

Chlorofluorocarbons (CFCs) – A group of inert, nontoxic, and easily liquefied chemicals (such as Freon) used in refrigeration, air conditioning, packaging, or insulation or as solvents or aerosol propellants.

Coastal Zone – Lands and waters adjacent to the coast that exert an influence on the uses of the sea and its ecology, or, adversely, whose uses and ecology are affected by the sea.

Command and Control, Battle Management, and Communications (C2BMC) – The overall integrator of the BMDS, would consist of electronic equipment and software that enable military commanders to receive and process information, make decisions, and communicate those decisions regarding the engagement of threat missiles.

Community Noise Equivalent Level – Describes the average sound level during a 24-hour day in dBA.

Component – Subsystem, assembly, or subassembly of logically grouped hardware and software, that performs interacting tasks to provide BMDS capability at a functional level.

Congenital – Any trait present at birth, whether the result of a genetic or non-genetic factor.

Controlled Airspace – Airspace of defined dimensions within which air traffic control service is provided to IFR flights and to VFR flights in accordance with the airspace classification. Controlled airspace is divided into five classes, dependent upon location, use, and degree of control: Class A, B, C, D, and E.

Controlled Firing Area – Airspace wherein activities are conducted under conditions so controlled as to eliminate hazards to non-participating aircraft and to ensure the safety or person and property on the ground.

Cooperating Agency – Any Federal agency, other than a lead agency, that has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment.

Council on Environmental Quality (CEQ) – Established by NEPA, the CEQ consists of three members appointed by the President. A CEQ regulation (Title 40 CFR 1500-1508, as of July 1, 1986) describes the process for implementing NEPA, including preparation of EAs and EISs, and the timing and extent of public participation.

Countermeasures – Tactical or technical actions taken to alter ballistic missile characteristics to hinder or prevent BMDSs from identifying or hitting the incoming missiles.

Criteria Pollutants – Pollutants identified by the U.S. EPA (required by the Clean Air Act to set air quality standards for common and widespread pollutants) and established under state ambient air quality standards. There are standards in effect for seven criteria pollutants: CO, lead, ozone, NO_2, PM_{10}, $PM_{2.5}$, and SO_2.

Critical Habitat – Specific areas within a geographical area occupied by threatened or endangered species at the time they are listed which contain the physical or biological features essential to conservation of the species and may require special management considerations or protection.

Cultural Resources – The prehistoric and historic artifacts, archaeological sites (including underwater sites), historic buildings and structures, and traditional resources (such as Native American and Native Hawaiian religious sites).

Cumulative Impact – The impact on the environment which results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Day/Night Average Sound Level (L_{dn}) – The average sound level during a 24-hour day, reported in dBA and used to predict human annoyance and community reaction to unwanted sound.

Decibel (dB) – A unit of measurement on a logarithmic scale which describes the magnitude of a particular quantity of sound pressure or power with respect to a standard reference value; the accepted standard unit for the measurement of sound.

Decommissioning – The removal or the rendering useless of obsolete or no longer needed components of the BMDS from service.

Demilitarization – The act of destroying a system's offensive and defensive capabilities to prevent the equipment from being used for its intended military purpose.

Deployment – Fielding a weapon system by delivering the completed production system to operational use with units in the field/fleet and placing it on alert.

Development – The various activities that would support research and development of the BMDS components and the overall system. Activities include planning, budgeting,

research and development, systems engineering, maintenance and sustainment, manufacture of test articles (prototypes) and initial testing, and tabletop exercises.

Directed Blast Fragmentation – Weapon technology that involves the interceptor approaching the threat ballistic missile and exploding close to it, thereby disrupting the path of the threat missile and possibly destroying it.

Disposal – The process of redistributing, transferring, donating, selling, abandoning, destroying or any other disposition of a property.

Dose-response relationship – The relationship between the dose of some agent (such as a drug), or the extent of exposure, and a physiological response. A dose-response effect means that as the dose increases, so does the effect.

Dosimetry – A general term applied to the practice of measuring radiation exposure.

Ecosystem – The set of biotic (living) and abiotic (nonliving) components in a given environment.

Effluent – An outflowing branch of a main stream or lake; waste material (such as smoke, liquid industrial refuse, or sewage) discharged into the environment.

Electroexplosive Device – A single unit, device, or subassembly, in which electrical energy is used to initiate an enclosed explosive, propellant, or pyrotechnic material.

Electromagnetic Radiation (EMR) – Waves of energy with both electric and magnetic components at right angles to one another.

Element – A complete, integrated set of components capable of autonomously providing BMDS capability.

Endangered Species – A plant or animal species that is threatened with extinction throughout all or a significant portion of its range.

Engagement Sequence – A unique combination of detect-control-engage functions performed by BMDS components (such as sensors, weapon and C2BMC equipment) used to engage a threat ballistic missile. The command and control, battle management, and fire control functions enable the engagement sequence functions.

Engagement Sequence Group (ESG) – The logical categorization of engagement sequences based upon common capabilities or characteristics (e.g., effectiveness or functionality). Creating ESGs requires identification of the components (e.g., sensors,

weapons and C2BMC equipment) that perform overlapping or similar functions in the execution of an engagement.

Environmental Justice – The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. EO 12898 requires identification of potential disproportionately high and adverse impacts on low-income and/or minority populations that may result from proposed Federal Actions.

Epidemiologic – Of or relating to epidemiology, which is the branch of medicine that deals with the study of the causes, distribution, and control of disease in populations.

Equivalent Noise Level (L_{eq}) – Energy mean A-weighted sound level during a stated measurement period.

Erosion – The wearing away of a land surface by water, wind, ice, or other geologic agents.

Essential Fish Habitat – Those waters and substrate (sediment, hard bottom) necessary to fish for spawning, breeding, feeding or growth to maturity.

Estuary – A water passage where the tide meets a river current; an arm of the sea at the lower end of a river; characterized by brackish water.

Exclusive Economic Zone – An offshore boundary, set at 200 nautical miles (320 km), establishing a nation's economic sovereignty over the resources present within that perimeter.

Exoatmosphere – The outer most part of the earth's atmosphere.

Explosive Safety Quantity-Distance (ESQD) – The quantity of explosive material and distance separation relationships providing defined types of protection based on levels of risk considered acceptable.

Fielding – Activities which include acquiring and transferring BMDS components to military services.

Flight Level (FL) – A level of constant atmospheric pressure related to a reference datum of 76 centimeters (29.92 inches) of mercury stated in three digits that represent hundreds of feet. For example, FL 250 represents a barometric altimeter indication of 7,620 meters (25,000 feet); FL 255 represents an indication of 7,772 meters (25,500 feet).

Flight Termination System (FTS) – All components, onboard a launch vehicle, which provide the ability to end a launch vehicles flight in a controlled manner. An FTS consists of all command destruct systems, inadvertent separation destruct systems, or other systems or components that are onboard a launch vehicle and used to terminate flight.

Floodplain – Areas of low-level ground present along a river or stream channel. Such lands may be subject to periodic or infrequent inundation due to rain or melting snow.

Fugitive Dust – Any solid PM that becomes airborne, other than that emitted from an exhaust stack, directly or indirectly as a result of the activities of man. Fugitive dust may include emissions from haul roads, wind erosion of exposed soil surfaces, and other activities in which soil is either removed or redistributed.

Functional Capabilities – The functional capabilities of the proposed BMDS are to detect, identify, track, discriminate, intercept, and destroy a threat ballistic missile during a specific phase of flight. They also include the long-term flexibility of the BMDS to evolve to meet future threats whether they are technological or geographic in nature.

Geologic Hazards – Geologic phenomena such as landslides, flooding, ground subsidence, volcanic activity, faulting, earthquakes, and tsunamis (tidal waves).

Geology – The study of the composition and configuration of the Earth's surface and subsurface features.

Geosynchronous Earth Orbit (GEO) – An orbit approximately 36,000 kilometers (22,000 miles) in altitude that is synchronized with Earth's rotation.

Gestational – Referring to the period of pregnancy from conception to birth.

Global Positioning System (GPS) – A space-based radio positioning, navigation, and time-transfer system. The system provides highly accurate position and velocity information, and precise time, on a continuous global basis to unlimited number of properly equipped users. The system is unaffected by weather, and provides a worldwide common grid reference system.

Greenhouse Gases – Atmospheric gases (principally CO_2, water vapor, nitrous oxide, chlorofluorocarbons, and methane) that absorb infrared radiation and contribute to the "greenhouse effect."

Ground water – Water within the earth that supplies wells and springs; specifically, water in the zone of saturation where all openings in rocks and soil are filled, the upper surface of which forms the water table.

Habitat – The area or type of environment in which a species of ecological community normally occurs.

Hazardous Air Pollutants (HAPs) – A group of 188 chemicals identified in the 1990 Clean Air Act Amendments. Exposure to these pollutants can cause or contribute to cancer, birth defects, genetic damage, and other adverse health effects.

Hazardous Material – A substance that can cause, because of its physical or chemical properties, an unreasonable risk to the health and safety of individuals, property, or the environment.

Hazardous Waste – A waste, or combination of wastes, which, because of its quantity, concentration, or physical, chemical, or infectious characteristics, may either cause or significantly contribute to an increase in mortality or an increase in serious irreversible illness or pose a substantial present or potential hazard to human health or the environmental when improperly treated, stored, transported, disposed of, or otherwise managed.

Health and Safety – Includes consideration of any activities, occurrences or operations that have the potential to affect the well being, safety, or health of workers or members of the general public.

Hertz – A unit of frequency equal to one cycle per second.

Historic Properties – Under the National Historic Preservation Act, these are properties of national, state, or local significance in American history, architecture, archaeology, engineering, or culture, and worthy of preservation.

Hit-to-Kill Technology – Using only the force of the direct collision to destroy the target.

Hypergolic – The self-ignition of a fuel and an oxidizer upon mixing with each other without a spark or other external energy.

Hyperthyroidism – Overactivity of the thyroid gland resulting in an excess of thyroid hormone production.

Hypothyroidism – Underactivity of the thyroid gland resulting in a deficiency of thyroid hormone production.

Immediately Dangerous to Life and Health (IDLH) – An atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or

would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

Immunologic response – A biological defense function that recognizes and responds to foreign substances introduced into the body.

Impacts (Effects) – An assessment of the meaning of changes in all attributes being studied for a given resource; an aggregation of all the adverse effects, usually measured using a qualitative and nominally subjective technique.

Infrared – A range of electromagnetic-radiation wavelengths longer than visible light and shorter than microwave wavelengths.

Infrared Sensors – A sensor designed to detect the EMR in the wavelength region of 1 to 40 microns.

Infrastructure – The system of public works of a country, state, or region, such as utilities or communication systems; resource area analyzed in NEPA documents.

Initial Defensive Capability (IDC) – The sensors, C2BMC, and weapons from the Block 04 Toolbox that are available for limited, militarily useful capability by September 2004. This initial defense capability includes early warning and tracking sensors based on land, at sea, and in space, command and control, and ground-based interceptors for midcourse and terminal intercepts.

Initial Defensive Operations (IDO) – The acceptance of the IDC by the combatant commander based on military utility. To declare IDO the combatant commander determines through military judgment that adequate doctrine, organization, training, materiel, leadership, personnel, and facilities exist to operate the system.

Institute of Electrical and Electronics Engineers (IEEE) – A non-profit, technical professional association of engineers with expertise in computer engineering, biomedical technology, telecommunications, electric power, aerospace and consumer electronics, which creates consensus-based standards.

Instrument Flight Rules (IFR) – Rules governing the procedures for conducting instrument flight; also a term used by pilots and controllers to indicate type of flight plan.

Integrated Ground Test (GT) – A test that uses tactical BMDS Element hardware and software in conjunction with modeling and simulation assets to simulate and stimulate Elements. Integrated Ground Tests are used to collect data for risk reduction and for scenario exploration where flight-testing is either impractical or impossible. This data

provides a stronger understanding of each component and how it reacts in different situations and enables each component to be tested with other components.

Integrated Missile Defense Wargames – Simulations of military operations involving two or more opposing forces, using rules, data, and procedures designed to depict an actual or assumed real-life situation. They are designed to gain insight into how human decision-making affects the use of BMDS components.

Ion Chromatography - A form of liquid chromatography that uses ion-exchange resins to separate atomic or molecular ions based on their interaction with the resin.

Ionizing Radiation – Particles or photons that have sufficient energy to produce direct ionization in their passage through a substance. X-rays, gamma rays, and cosmic rays are forms of ionizing radiation.

Ionosphere – The part of the earth's upper atmosphere which is sufficiently ionized by solar ultraviolet radiation so that the concentration of free electrons affects the propagation of radio waves. Its base is at about 70 or 80 kilometers (43 to 50 miles) and it extends to an indefinite height.

Jet Route – A route designed to serve aircraft operating from 5,486 meters (18,000 feet) up to and including FL 450, referred to as J routes with numbering to identify the designated route.

Jettison - The disposal of unwanted equipment or material by establishing it in a trajectory that will allow a predictable reentry into the atmosphere.

Kill Vehicle (KV) – The portion of the interceptor that performs the intercept and destroys the threat missile.

Kinetic Energy – The energy from the momentum of an object, i.e., an object in motion.

Land Use – The human use of land resources for various purposes, including economic production, natural resources protection, or institutional uses.

Laser – An active-electron device that converts input power into a very narrow, intense beam of coherent visible or infrared light. The input power excites the atoms of an optical resonator to a higher-energy level, and the resonator forces the excited atoms to radiate in phase. Derived from Light Amplification by Stimulated Emission of Radiation and classified from Class I to Class IV according to its potential for causing damage to the eye.

Laser Sensor – A sensor that uses laser energy of various energy levels and frequencies to illuminate an object to detect the object's motion.

Leaching – The process by which soluble materials in the soil, such as salts, nutrients, pesticide chemicals, or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

Low Earth Orbit (LEO) – An orbit at an altitude approximately 1,600 kilometers (1,000 miles) above the surface of the Earth.

Lowest Observed Adverse Effect Level (LOAEL) – The lowest exposure level at which there are biologically significant increases in frequency or severity of adverse effects between the exposed population and its appropriate control group.

Lead (Pb) – A heavy metal which can accumulate in the body and cause a variety of negative effects; one of the six pollutants for which there is a NAAQS (see Criteria Pollutants).

Lethality – A measure of the ability of the BMDS to prevent a threat ballistic missile from producing lethal effects.

Lethality Enhancers – Non-nuclear explosive devices that increase the probability of destroying the threat missile and its payload (e.g., explosives, chemical or biological agents).

Material Safety Data Sheet – Presents information, required under the Occupation Safety and Health Act Standards, on a chemical's physical properties, health effects, and use precautions.

Maximum Permissible Exposure (MPE) – Established by the Nuclear Regulatory Commission, an exposure standard set at a level where apparent injury from ionizing radiation during a normal lifetime is unlikely.

Mean Sea Level (MSL) – The average height of the sea surface if undisturbed by waves, tides, or winds.

Mesosphere – The atmospheric shell between about 45 to 55 kilometers (28 to 34 miles) and 80 to 85 kilometers (50 to 53 miles), extending from the top of the stratosphere to the mesopause; characterized by a temperature that generally decreases with altitude.

Midcourse Phase – That portion of a ballistic missile's trajectory between the boost phase and the reentry phase when reentry vehicles and penaids travel at ballistic trajectories above the atmosphere. During this phase, a missile releases its warheads and

decoys and is no longer a single object, but rather a swarm of reentry vehicles and penaids falling freely along present trajectories in space.

Military Operating Area (MOA) – An airspace assignment of defined vertical and lateral dimensions established outside Class A areas to separate certain military activities from IFR traffic and to identify for VFR traffic where these activities are conducted.

Military Training Routes – Airspace of defined vertical and lateral dimensions established for the conduct of military flight training at airspeeds in excess of 250 knots.

Missile – A projectile weapon that is fired or otherwise propelled toward a target.

Missile Defense Integration Exercises (MDIE) – Test activities that support the characterization of the degree of integration and interoperability among the BMDS block elements to operate as a single system

Mitigation – A method or action to reduce or eliminate adverse environmental impacts.

Mixing Height – Altitude at which pollutants and atmospheric gases are thoroughly combined.

Mobile Sources – Any movable source that emits any regulated air pollutant.

National Airspace System (NAS) – The common network of U.S. airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations and procedures, technical information, and manpower and material. Included are system components shared jointly with the military.

National Ambient Air Quality Standards (NAAQS) – Set by the U.S. EPA under Section 109 of the Clean Air Act, nationwide standards for limiting concentrations of certain widespread airborne pollutants to protect public health with an adequate margin of safety (primary standards) and to protect public welfare, including plant and animal life, visibility and materials (secondary standards). Currently, seven pollutants are regulated: CO, lead, NO_2, ozone, particulate matter with a diameter of less than ten microns, particulate matter with a diameter of less than 2.5 microns, and SO_2 (see Criteria Pollutants).

National Environmental Policy Act (NEPA) – Public law 91-190, passed by Congress in 1969. The Act established a national policy designed to encourage consideration of the influences of human activities, such as population growth, high-density urbanization, or industrial development, on the natural environment. NEPA procedures require that environmental information be made available to the public before decisions are made.

Information contained in NEPA documents must focus on the relevant issues to facilitate the decision-making process.

National Register of Historic Places – A register of districts, sites, buildings, structures, and objects important in American history, architecture, archaeology, and culture, maintained by the Secretary of the Interior under authority of Section 2 (b) of the Historic Site Act of 1935 and Section 101 (1) of the National Historic Preservation Act of 1966, as amended.

Nitrogen Dioxide (NO_2) – Gas formed primarily from atmospheric N_2 and oxygen when combustion takes place at high temperatures; one of the six pollutants for which there is a NAAQS (see Criteria Pollutant).

Nitrogen Oxides (NO_X) – Gases formed primarily by fuel combustion.

Noise – Unwanted or annoying sound typically associated with human activity; resource area analyzed in NEPA documents.

Non-attainment Area – An area that has been designated by the U.S. EPA or the appropriate state air quality agency as exceeding one or more of the national or state ambient air quality standards.

Non-ionizing Radiation –EMR at wavelengths whose corresponding photon energy is not high enough to ionize an absorbing molecule. All radio frequency, infrared, visible, and near ultraviolet radiation are non-ionizing.

Nonpoint Source – Type of pollution originating from a combination of sources.

Notice to Airmen (NOTAM) – A notice containing information, not known sufficiently in advance to publicize by other means, the establishment, condition, or change in any component (facility, service, or procedure of, or hazard in the National Airspace System) the timely knowledge of which is essential to personnel concerned with flight operations.

Notice to Mariners (NOTMAR) – A notice containing information, not known sufficiently in advance to publicize by other means, the establishment, condition, or change in any component (facility, service, or procedure of, or hazard in the broad ocean area) the timely knowledge of which is essential to personnel concerned with sea-based activities.

Orbital Debris – Material that is on orbit as the result of space initiatives, but is no longer serving any function.

Ozone – A compound consisting of three oxygen atoms; one of the six pollutants for which there is a national ambient air quality standard (see Criteria Pollutant).

Ozone-Depleting Substances – A group of chemicals that are inert under most conditions but within the stratosphere react catalytically to reduce ozone to oxygen.

Particulate Matter (PM) – Particles small enough to be airborne, such as dust or smoke (see Criteria Pollutants); one of the six pollutants for which there is a NAAQS (see Criteria Pollutant).

Passive Sensor – A sensor that detects naturally occurring emissions from a target for tracking and/or identification purposes.

Permafrost – Permanently frozen subsoil, for a minimum of 2 years, occurring in perennially frigid areas.

Permissible Exposure Limit (PEL) – Exposure level expressed in electric field, magnetic field, or plane wave power density to which an individual may be exposed and which, under conditions of exposure, will not cause detectable bodily injury in light of present medical knowledge.

Platform – Location from which a missile, target, or other test object is launched.

PM_{10} – Particulate matter less than or equal to 10 micrometers in diameter.

$PM_{2.5}$ – Particulate matter less than or equal to 2.5 micrometers in diameter.

Point Source – A distinct and identifiable source, such as a sewer or industrial outfall pipe, from which a pollutant is discharged.

Pounds per Square Foot – Measure of pressure, used to measure sonic booms.

Population Density – The average number of individuals per unit of space.

Programmatic Environmental Impact Statement (PEIS) – A document prepared in accordance with NEPA for the adoption of programs, such as a group of concerted actions to implement a specific policy or plan; systematic and connected agency decisions allocating agency resources to implement a specific statutory program or executive directive (40 CFR 1508.18). As defined in 40 CFR 1508.28, such documents assist in tiering, which refers to the coverage of general matters in broader EISs (such as national program or policy statements) with subsequent narrower statements or environmental analyses (such as regional or basin-wide program statements or ultimately

site-specific statements) incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared.

Propellants – Balanced mixtures of fuel and oxidizer designed to produce large volume of hot gases at controlled, predetermined rates, once the burning reaction is initiated.

Radar – A radio device or system for locating an object by means of radio waves reflected from the object and received, observed, and analyzed by the receiving part of the device in such a way that characteristics (such as distance and direction) of the object may be determined.

Region of Influence – The geographical region that would be expected to be affected in some way by the Proposed Action and alternatives.

Restricted Area – Airspace designated under FAA Regulation part 73, within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Most restricted areas are designated joint use, and IFR/VFR operations in the area ay be authorized by the controlling air traffic control facility when it is not being utilized by the using agency. Restricted areas are depicted on en route charts.

Scoping – A process initiated early during preparation of an EIS to identify the scope of issues to be addressed, including the significant issues related to the Proposed Action. During scoping, input is solicited from affected agencies as well as the interested public. (40 CFR 1501.7)

Sensitive Habitat – Habitat that is susceptible to damage from intrusive actions.

Short Term Exposure Limit (STEL) – The level of exposure that must not be exceeded at any time during a workday when the exposure is averaged over 15 minutes.

Socioeconomics – The basic attributes and resources associated with the human environment, in particular population and economic activity.

Soils – The unconsolidated materials overlying bedrock or other parent materials. Soils are typically described in terms of their composition, slope, and physical characteristics.

Solid Rocket Motor Propellant – A fuel/oxidizer mix that continually combusts when ignited.

Solid Waste – Municipal waste products and construction and demolition materials; includes non-recyclable materials with the exception of yard waste.

Solvent – A substance that dissolves or is capable of dissolving a substance.

Sonic Boom – Sound, resembling an explosion, produced when a shock wave formed at the nose of an aircraft or launch vehicle traveling at supersonic speed reaches the ground.

Special Use Airspace – Airspace of defined dimensions identified by an area on the surface of the earth wherein activities must be confined because of their nature and/or wherein limitations may be imposed upon non-participating aircraft.

Spiral Development – An iterative process for developing a defined set of capabilities within one increment. This process provides the opportunity for interaction between the user, tester, and developer. In this process, the requirements are refined through experimentation and risk management, there is continuous feedback, and the user is provided the best possible capability within the increment. Each increment may include a number of spirals. Spiral development implements evolutionary acquisition.

State Historic Preservation Officer – The official within each state, authorized by the state at the request of the Secretary of the Interior, to act as liaison for purposes of implementing the National Historic Preservation Act.

Stationary Source – Any building, structure, facility, installation, or other fixed source that emits any regulated air pollutant.

Stratosphere – The atmospheric shell above the troposphere and below the mesosphere; it extends from the tropopause to about 55 kilometers (34 miles), where the temperature begins again to increase with altitude.

Sulfur Dioxide (SO_2) – A toxic gas that is produced when fossil fuels, such as coal and oil, are burned; one of the six pollutants for which there is a NAAQS (see Criteria Pollutant).

Surface Water – Water resource that consists of lakes, rivers and streams.

Support Assets – Auxiliary equipment and infrastructure that facilitate BMDS operations.

Sustainment – Includes various maintenance and operating activities as they pertain to deploying the BMDS.

System Integration Flight Tests (SIFTs) – Tests designed to measure BMDS component interoperability and assess BMDS functional capabilities in each developmental Block.

System Integration Tests– Tests designed to assess the ability of the BMDS components to work as a unit and to meet the required functional capabilities.

Targets – Launch systems, payloads including countermeasures and re-entry vehicles, and extensive instrumentation and avionics designed to test the performance of missile defense sensors and weapons.

Telemetry – Automatic data measurement and transmission from remote sources, such as space vehicles, to receiving station for recording and analysis.

Terminal Phase – That final portion of a ballistic missile's trajectory between the midcourse phase and trajectory termination.

Test Assets – Assets used for testing that are not components of the BMDS but are critical to its effective development and testing; these include test range facilities, sensors used only for test purposes, targets, countermeasure devices and warhead simulants.

Test Bed – The collection of integrated BMD element development hardware, software, prototypes, and surrogates, as well as supporting test infrastructure (e.g., instrumentation, safety/telemetry systems, and launch facilities) configured to support realistic development and testing of the BMDS.

Test – Any program or procedure which is designed to obtain, verify, or provide data for the evaluation of any of the following: 1) progress in accomplishing developmental objectives, 2) the performance, operational capability and suitability of systems, subsystems, components, and equipment items, and 3) the vulnerability and lethality of systems, subsystems, components, and equipment items.

Theater – The geographical area outside the continental United States for which a commander of a unified or specified command has been assigned.

Theater Ballistic Missile – A ballistic missile whose target is within a theater or which is capable of attacking targets in a theater.

Theater Missile Defense (TMD) – The strategies and tactics employed to defend a geographical area outside the United States against attack from short-range, intermediate-range, or medium-range ballistic missiles.

Threatened Species – A plant or animal species likely to become endangered in the foreseeable future.

Threshold Limit Value (TLV) – The upper values of a toxicant concentration to which an average healthy person may be repeatedly exposed to day after day without suffering adverse effects.

Topography – The configuration of a surface including its relief and the position of its natural and man-made features.

Trajectory – The curve described by an object moving through space.

Transportation – Resource area analyzed in NEPA documents that encompasses ground, aviation, and ocean transport systems.

Troposphere – The portion of the atmosphere from the earth's surface to the tropopause, that is, the lowest 10 to 20 kilometers (6 to 12 miles) of the atmosphere. It is the turbulent and weather region containing 75% of the total mass of the Earth's atmosphere. It is characterized by decreasing temperature with increasing altitude. The manor components of the troposphere are N_2 (76.9%) and oxygen (20.7%).

Uncontrolled Airspace – Uncontrolled airspace, or Class G airspace, has no specific definition but generally refers to airspace not otherwise designated and operations below 365.7 meters (1,200 feet) above ground level. No air traffic control service to either IFR or VFR aircraft is provided other than possible traffic advisories when the air traffic control workload permits and radio communications can be established.

Utilities – Refers to those facilities and systems that provide power, water, wastewater treatment, and the collection and disposal of solid waste.

Visible Technology Sensors – Generally passive sensors that detect objects of missiles by collecting light energy or radiation emitted from the target in wavelengths visible to the human eye.

Visual Flight Rules (VFR) – Rules that govern the procedures for conducting flight under visual conditions. Pilots and controllers also use them to indicate type of flight plan.

Visual Resources – The natural and man-made features that constitute the aesthetic qualities of an area.

Volatile Organic Compound (VOC) – One of a group of chemicals that react in the atmosphere with NO_X in the presence of heat and sunlight.

Wastewater – Water that has been previously utilized; sewage.

Water Resources – Resource area analyzed in NEPA documents, which includes surface water, ground water, and floodplains.

Wetlands – Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. This classification includes swamps, marshes, bogs, and similar areas.

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EXECUTIVE SUMMARY

Introduction

The National Environmental Policy Act (NEPA) of 1969, as amended; the Council on Environmental Quality (CEQ) regulations that implement NEPA (Code of Federal Regulations [CFR], Title 40, Parts 1500-1508); Department of Defense (DoD) Instruction 4715.9 *Environmental Planning and Analysis*; applicable service environmental regulations that implement these laws and regulations; and Executive Order (EO) 12114, Environmental Effects Abroad of Major Federal Actions (whose implementation is guided by NEPA and the CEQ implementing regulations) direct DoD lead agency officials to consider potential impacts to the environment when authorizing or approving Federal actions.

This Programmatic Environmental Impact Statement (PEIS) evaluates the potential environmental impacts of activities associated with the development, testing, deployment, and planning for decommissioning of the Ballistic Missile Defense System (BMDS). This PEIS considers the current technology components, assets, and programs that make up the proposed BMDS as well as the development and application of new technologies, and considers cumulative impacts of implementing the BMDS. A programmatic NEPA evaluation is the appropriate approach for projects that are large in scope, diverse geographically, and implemented in phases over many years. It provides the analytical framework that supports subsequent NEPA analysis of specific actions at specific locations within the overall system, i.e., tiering.

Purpose and Need for the Proposed Action

The purpose of the proposed action is for the Missile Defense Agency (MDA) to incrementally develop and field a BMDS that layers defenses to intercept ballistic missiles of all ranges in all phases of flight. The proposed action is needed to protect the United States (U.S.), its deployed forces, friends, and allies from ballistic missile threats. The BMDS is a key component of U.S. policy for addressing ballistic missile threats worldwide.

Proposed Action

The MDA is proposing to develop, test, deploy, and to plan for related decommissioning activities for an integrated BMDS using existing infrastructure and capabilities, when feasible, as well as emerging and new technologies, to meet current and evolving ballistic missile threats. The Secretary of Defense assigned this critical defense mission to the MDA.

Scope of the PEIS

This PEIS identifies, evaluates, and documents the potential environmental effects of developing, testing, deploying, and planning for the eventual decommissioning of a BMDS. Although extensive environmental analysis already exists for many of the existing and projected components of the proposed BMDS, this PEIS examines potential environmental impacts of MDA's concept for developing an integrated system, based on current Congressional and Presidential direction. The BMDS PEIS also assesses whether cumulative environmental effects would result from implementing the proposed action. Further, the BMDS PEIS provides the analytical framework for tiering subsequent specific NEPA analyses of activities including increasingly complex and robust System Integration Testing.

Consultation and Coordination

The MDA, as the lead agency responsible for preparing this PEIS, is required to coordinate with affected Federal, state, local, and tribal agencies, and other interested parties. The MDA identified several agencies that may be cooperating or consulting agencies within the requirements of NEPA for this PEIS. These agencies include National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries Service), U.S. Fish and Wildlife Service, the Advisory Council on Historic Preservation (ACHP), and the Federal Aviation Administration (FAA).

Consulting agencies may submit comments and provide data to support the environmental analysis, but they do not participate in the internal review of documents, issues, and analyses. A cooperating agency is any Federal agency, other than a lead agency, that has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or reasonable alternative) for legislation or other Federal action significantly affecting the quality of the human environment. (40 CFR 1508.5) MDA has held informal meetings with several agencies; however, MDA has not requested that any agencies participate as cooperating agencies for this PEIS.

Public Involvement

The MDA provided several opportunities and means for public involvement throughout the preparation of the BMDS PEIS. The CEQ implementing regulations for NEPA describe the public involvement requirements for agencies. (40 CFR 1506.6) Public participation in the NEPA process provides for and encourages open communication between the MDA and the public, thus promoting better decision-making.

Public involvement for the development of the BMDS PEIS began with the publication of the Notice of Intent (NOI) in the *Federal Register* (FR) (68 FR 17784) on April 11, 2003. The MDA invited the participation of Federal, state, and local agencies, Native

American Tribes, environmental groups, organizations, citizens, and other interested parties to assist in determining the scope and significant issues to be evaluated in the BMDS PEIS. MDA held public scoping meetings in accordance with CEQ regulations. (40 CFR 1501.7) Meetings took place in Arlington, Virginia on April 30, 2003; Sacramento, California on May 6, 2003; Anchorage, Alaska on May 8, 2003; and Honolulu, Hawaii on May 13, 2003. The purpose of the scoping meetings was to solicit input from the public on concerns regarding the proposed activities as well as to gather information and knowledge of issues relevant to analyzing the environmental impacts of the BMDS. The public scoping meetings also provided the public with an opportunity to learn more about the MDA's proposed action and alternatives. The MDA developed a publicly accessible web site, http://www.mda.mil/mdalink/html/mdalink.html, to provide information on the BMDS PEIS and request scoping comments. The MDA also established a toll-free phone and fax line, e-mail address, and U.S. postal service mailbox for submittal of public comments and questions.

During scoping, the MDA received 285 comments. Comments received pertaining to reasonable alternatives to the proposed action, resource areas, human health, and environmental impacts have been considered in this PEIS.

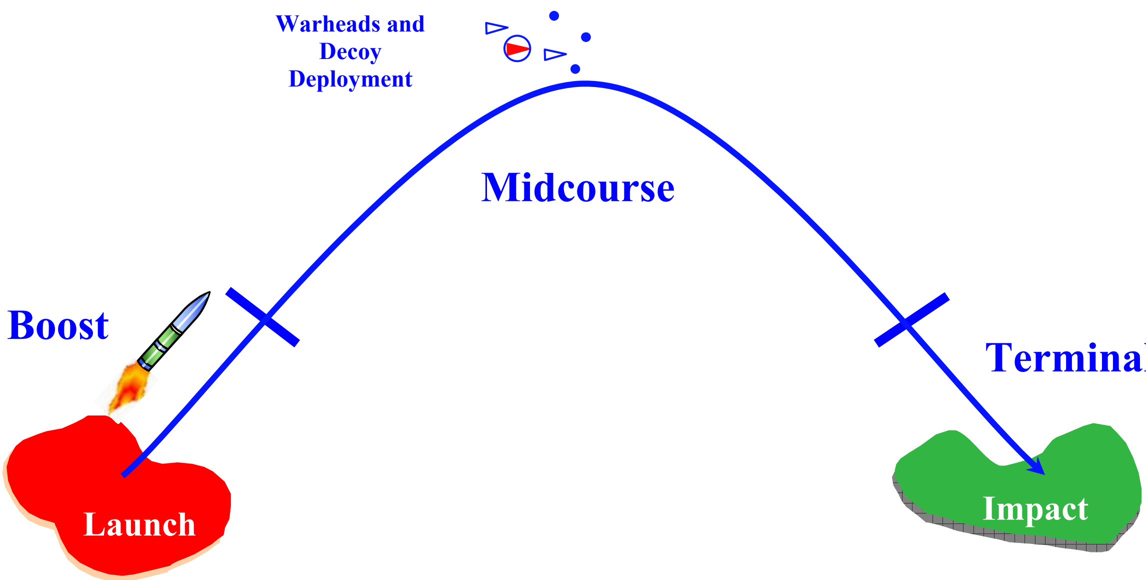
The public comment period began with the publication of the Notice of Availability (NOA) on September 17, 2004 in the FR by the Environmental Protection Agency (EPA). The NOA announced the availability of the Draft PEIS and requested comments on it. A downloadable version of the Draft PEIS was available on the BMDS PEIS web site and hardcopies of the document were placed in public libraries in the cities holding the public hearings. In October, 2004 MDA held public hearings in Arlington, Virginia; Sacramento, California; Anchorage, Alaska; and Honolulu, Hawaii. The MDA also placed legal notices in local and regional newspapers and notified state representatives of the public hearings. The purpose of these hearings was to solicit comments on the environmental areas analyzed and considered in the Draft PEIS. Appendix B contains a detailed description of the public comment period and a reproduction of the transcripts of the public hearings. The MDA's consideration of the approximately 8,500 comments received on the Draft PEIS and responses to in-scope comments can be found in Appendix K of this PEIS. Additional areas of analysis—orbital debris, perchlorate, and radar impacts to wildlife—are addressed in more technical detail in Appendices L, M, and N. The Final BMDS PEIS will be available for download at the site address listed above.

The Proposed BMDS

Conceptually, the BMDS would be a layered system of defensive weapons (i.e., lasers and interceptors); sensors (i.e., radars, infrared, optical, and lasers); Command and Control, Battle Management, and Communications (C2BMC); and support assets (i.e., auxiliary equipment, infrastructure and test assets); each with specific functional

capabilities, working together to defend against all classes and ranges of threat ballistic missiles in the three flight phases. A flight phase is a portion of the path taken by a threat missile moving through the atmosphere or space. The three flight phases of a ballistic missile are boost, midcourse, and terminal. Exhibit ES-1 describes these three phases. Multiple defensive weapons would be used to create a layered defense comprised of multiple intercept opportunities.

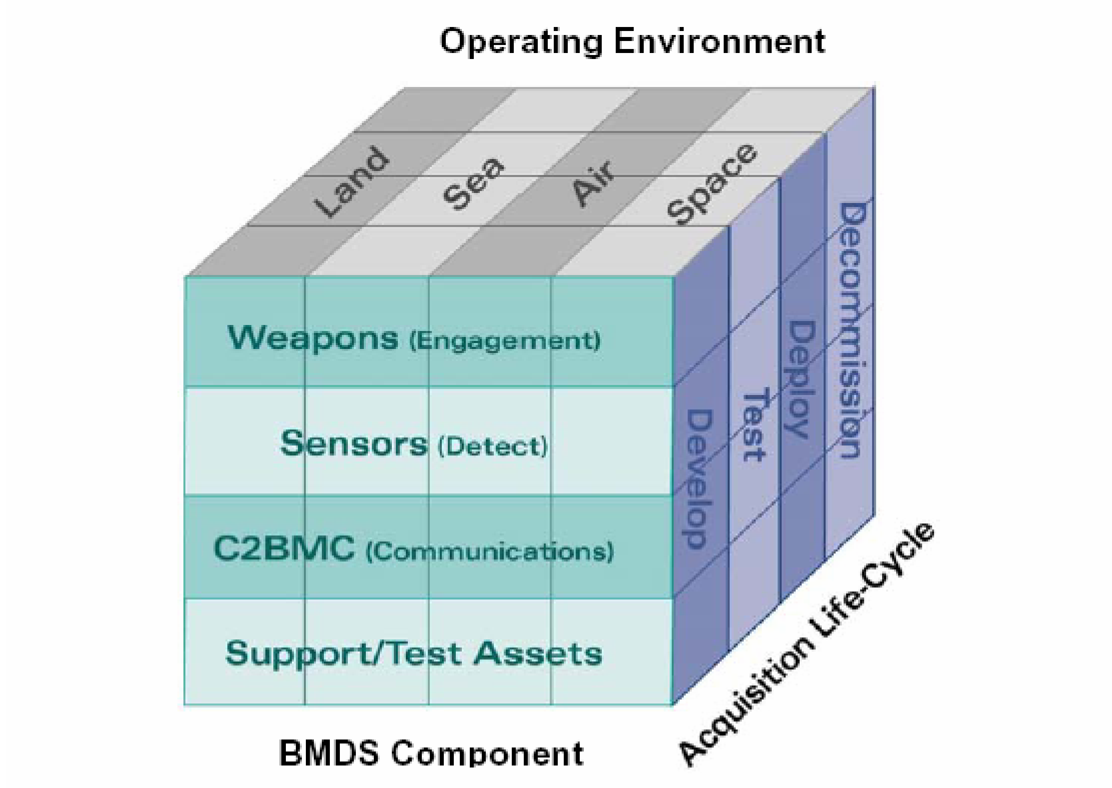
Exhibit ES-1. Ballistic Missile Flight Phases



Flight Phase	Description
Boost	First phase - rocket engine is ignited, missile lifts off and sets out on a specific path.
Midcourse	Second phase - begins when the rocket engine cuts off and the missile continues on a ballistic trajectory. Warheads and decoys may be deployed in this phase.
Terminal	Third phase - final portion of a ballistic trajectory between the midcourse phase and trajectory termination.

To determine environmental impacts, this PEIS analyzes the proposed BMDS in terms of its components, i.e., weapons, sensors, C2BMC, and support assets. These components become part of the BMDS through the acquisition life cycle phases – develop, test, deploy, and decommission. The components and activities could occur in various land, sea, air, and space operating environments. Exhibit ES-2 depicts the multi-dimensional complexities involved in considering the impacts of implementing an integrated BMDS.

Exhibit ES-2. Complexities of an Integrated BMDS



Components of the BMDS

The proposed BMDS would be comprised of components, i.e., weapons, sensors, C2BMC, and support assets. These are the systems and subsystems of logically grouped hardware and software that perform interacting tasks to provide BMDS functional capabilities. Historically, MDA primarily focused on developing stand-alone elements with specific defensive capabilities. The proposed approach maximizes flexibility to develop and test an integrated system while allowing initial capabilities to be fielded.

- **Weapons**. Weapons consisting of interceptors and high energy lasers (HELs) would be used to negate threat missiles. Interceptors would use either direct impact or directed fragmentation technology. BMDS weapons are designed to intercept threat ballistic missiles in one or more phases of flight and could be activated from land, sea-, air-, or space-based platforms.

- **Sensors**. BMDS sensors provide the relevant incoming data for threat ballistic missiles. They acquire, record, and process data on threat missiles and interceptor missiles; detect and track threat missiles; direct interceptor missiles or other defenses (e.g., lasers); and assess whether a threat missile has been destroyed. These sensors include signal-processing subcomponents, which receive raw data and use hardware and software to process these data to determine the threat missile's location, direction,

velocity, and altitude. The data from these sensors would travel through the communication systems of the proposed BMDS to Command and Control (C2) where a decision would be made to employ a defensive weapon such as launching an interceptor. The technologies used by existing and proposed BMDS sensors are based on the frequency or electromagnetic (EM) energy spectrum used by the sensor and include radar, infrared, optical, and laser systems.

- **C2BMC**. C2BMC would effectively integrate all components of the BMDS and would consist of electronic equipment and software that enable military commanders to receive and process information, make decisions, and communicate those decisions regarding the engagement of threat missiles. Specifically, C2BMC would receive, fuse, and display tracking and status data from multiple components so that commanders at various locations would have the same integrated operating picture and could make coordinated decisions about deploying weapons. The BMDS C2BMC includes three primary parts, C2, Battle Management (BM), and Communications. C2 would provide an integrated architecture to plan, direct, control, and monitor BMDS activities. BM would control the launching or firing of missiles and integrate the surveillance, detect/track/classify, engage, and assess across the layered defenses. Communications would allow all BMDS components to exchange data and network with BMDS assets.

- **Support Assets**. Support assets would be used to facilitate BMDS development, testing, and deployment. Support assets include support equipment, infrastructure, and test assets. Support equipment includes general transportation and portable equipment (e.g., automotive, ships, aircraft, rail, generators); BMDS Test Bed equipment (e.g., aircraft, vehicles, ships, mobile launch platforms, operator control units, sensor operations equipment [antennas, electronic equipment, cooling units, prime power units]); and weapons basing platforms (e.g., Aegis Cruiser and Airborne Laser [ABL] aircraft). Infrastructure includes docks, shipyards, launch facilities, and airports/air stations. Test assets include test range facilities, targets (missiles and drones), countermeasure devices, simulants, test sensors, optical and infrared cameras, computers, and observation vehicles. These test assets would simulate a threat missile in a realistic environment and assess and provide data used to enhance the performance of BMDS components in negating those threats. Some of the equipment (i.e., radar and tracking stations) and infrastructure (e.g., launch facilities) and all of the test assets comprise the BMDS Test Bed.

Acquisition Life Cycle Phases

The MDA, as the acquisition agency for the BMDS, has implemented a new, more flexible approach to its development. This approach is capability driven and component-based. Capability-based planning allows MDA to develop capabilities and system performance objectives based on technology feasibility, engineering analyses, and the

potential capability of the threat. Spiral development is an iterative process for developing the BMDS by refining program objectives as technology becomes available through research and testing with continuous feedback among MDA, the test community, and the military operators. Thus, MDA can consider deployment of a missile defense system that has no specified final architecture and no set of operational requirements but which will be improved incrementally over time. Development, testing, and deployment of an integrated BMDS would occur over several years using this evolutionary, spiral development process. Each new technology would go through development; promising technologies would go through testing and demonstration; and proven technologies would be incorporated into the BMDS.

- **Development**. Development includes the various activities that would support research and development of the BMDS components and overall systems. This would include planning, budgeting, research and development, systems engineering, site preparation and construction, repair, maintenance and sustainment, manufacture of test articles and initial testing, including modeling, simulation, and tabletop exercises.

- **Testing**. Testing of the BMDS involves demonstration of BMDS elements and components through test and evaluation. The successful demonstration of the BMDS would rely on a robust testing program aimed at producing credible system characterization, verification, and assessment data. To confirm these capabilities, MDA would continue to develop Test Beds using existing and new land-, sea-, air-, and space-based assets. Some construction at various geographic locations would be required to support infrastructure and assets where BMDS components and the overall system would be tested. Testing of the BMDS includes ongoing and planned tests (e.g., ground tests [GTs], flight tests) of components that might be incorporated into the BMDS, as well as tests of the layered, integrated BMDS through increasingly realistic System Integration Tests through 2010 and beyond.

- **Deployment**. Deployment of the BMDS refers to the fielding (including the manufacture, site preparation, construction and transport of systems) and sustainment (including operations and maintenance, training, upgrades, and service life extension) of BMDS architecture. The evolving BMDS is intended to have the capability over time to deploy different combinations of interoperable components. Deployment also would involve the transfer of facilities, elements and programs to the military services. On December 17, 2002, President Bush directed the fielding of initial defensive operation (IDO) capabilities by 2004, which would provide limited protection to defend the U.S. against ballistic missile attack. In October 2004, MDA achieved a limited missile defense capability (LDC) when certain BMDS components could also be placed on alert and used in defensive operations.

- **Decommissioning**. Decommissioning would involve the demilitarization and final removal and disposal of the BMDS components and assets. Plans would be made for

decommissioning BMDS components by either demolition or transfer to other uses or owners.

Alternatives

In this PEIS, MDA considers two alternatives to implementing an integrated BMDS that address the use of weapons components from land-, sea-, air-, and space-based platforms in addition to the No Action alternative as required by NEPA.

- **Alternative 1**. Under Alternative 1, the MDA would develop, test, deploy, and plan to decommission land-, sea-, and air-based platforms for BMDS weapons components and related architecture and assets. Alternative 1 would include space-based sensors, but would not include space-based defensive weapons.

- **Alternative 2.** Under Alternative 2, the MDA would develop, test, deploy, and plan to decommission land-, sea-, air-, and space-based platforms for BMDS weapons components and related architecture and assets. Alternative 2 would be identical to Alternative 1, with the addition of space-based defensive weapons.

- **No Action Alternative**. Under No Action the MDA would not develop, test, deploy, or plan for decommissioning activities for an integrated BMDS. Instead, the MDA would continue existing development and testing of discrete systems as stand-alone missile defense capabilities. Individual systems would continue to be tested but would not be subjected to System Integration Tests.

Affected Environment

To assess the impacts of implementing the proposed BMDS, it is necessary to characterize the existing condition of the affected environment in the locations where various BMDS implementation activities are proposed to occur. The affected environment includes all land, air, water, and space environments where proposed activities are reasonably foreseeable. For this PEIS, the affected environment includes all existing locations for ranges, installations, and facilities that the MDA has used, uses, or proposes to use for the BMDS both in the U.S. and outside the continental U.S. MDA determined that activities associated with the proposed BMDS might occur in locations around the world. Therefore, the affected environment has been considered in terms of global biomes, broad ocean areas, and the atmosphere.

Each biome covers a broad region, both geographically and ecologically for both domestic and international locations where components of the proposed BMDS may be located or operated. Climate, geography, geology, and distribution of vegetation and wildlife determine the distribution of the biomes. Using biomes as affected environment designations enables future site-specific environmental documentation to tier from this

PEIS. Note that there are no reasonably foreseeable BMDS activities that would occur in Antarctica; therefore, it is not included among the terrestrial biomes.

The affected environment has been divided into nine terrestrial biomes, the Broad Ocean Area (BOA), and the Atmosphere. Exhibit ES-3 describes the affected environment, and Exhibit ES-4 illustrates the global distribution of the biomes.

Exhibit ES-3. Affected Environment Descriptions[1]

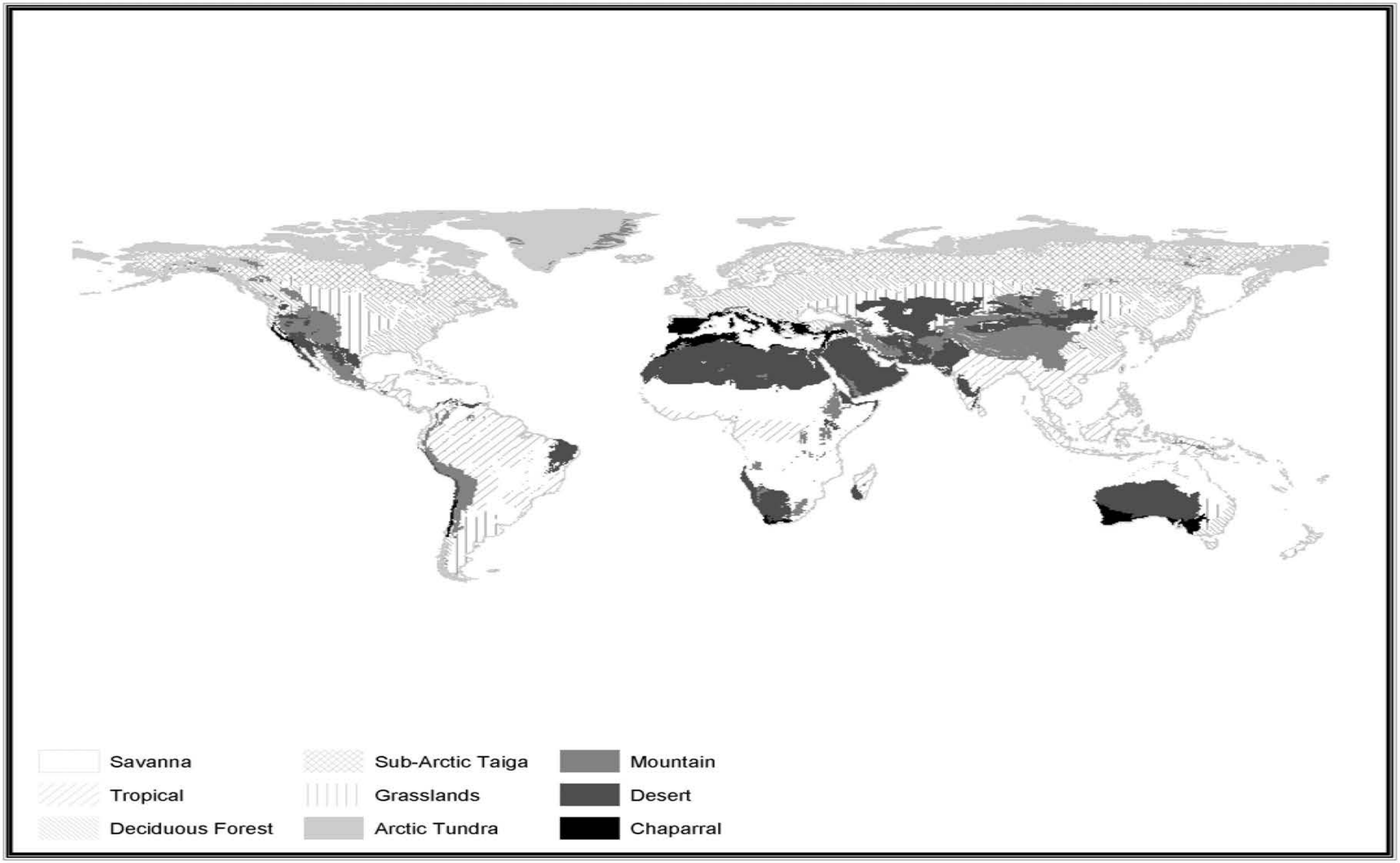
Description	Latitudinal Location	Areas of Interest for the BMDS
Arctic Tundra Biome	Areas above 60° North	Arctic regions of North America and the arctic coastal regions that border the North Atlantic Ocean, North Pacific Ocean, and Arctic Ocean, including parts of Alaska, Canada, and Greenland
Sub-Arctic Taiga Biome	Between 50° and 60° North	Sub-arctic regions of North America and sub-arctic coastal regions that border the North Pacific Ocean, including portions of Alaska
Deciduous Forest Biome	Mid-latitudes, between the polar regions and tropical regions	Eastern and northwestern U.S. and portions of Europe
Chaparral Biome	Western coastal regions of continents between 30° and 40° both North and South of the equator	Portion of the California coast and coastal region of the Mediterranean from the Alps to the Sahara Desert and from the Atlantic Ocean to the Caspian Sea
Grasslands Biome	No particular latitudinal range; occurs in the interior of all continents, except Antarctica	Prairie regions of Midwestern U.S.
Desert Biome	Between 15° and 35° both North and South of the equator	Arid environment of southwestern U.S.

[1] The latitudinal designations identify the general location for each biome; however, the biomes do not have rigid edges that begin and end at these latitudes. Therefore, there may be some overlap of biomes at or near these latitudinal designations.

Exhibit ES-3. Affected Environment Descriptions[1]

Description	Latitudinal Location	Areas of Interest for the BMDS
Mountain Biome	No particular latitudinal range; applies to areas with high elevations just below and above the snow line of a mountain	Rocky Mountains in the western U.S. and Alps in Central Europe
Tropical Biome	Between 23.5° North (Tropic of Cancer) and 23.5° South (Tropic of Capricorn)	Pacific Equatorial Islands
Savanna Biome	Between 5° and 20° both North and South of the equator	Northern Australia
BOA	No particular latitudinal range	Pacific, Atlantic and Indian Oceans
Atmosphere	No particular latitudinal range; refers to the atmosphere that envelops the entire Earth	Four principal atmospheric layers: troposphere, stratosphere, mesosphere, and ionosphere (or thermosphere)

Exhibit ES-4. Map of Global Biomes



Source: Modified From National Geographic, 2003b

The characteristics (e.g., climate, soil types, flora and fauna) that define global biomes are the same regardless of whether the biome area of concern is coastal or inland. However, unique features (e.g., wetlands, estuaries, wind currents, hurricanes) of coastal biome areas may affect the environmental impacts. Therefore, the Affected Environment discusses these unique features within the biome descriptions. Describing coastal areas as part of the larger inland biomes minimizes repetition among the descriptions yet captures the important aspects of the coastal areas in a way suitable for impacts analysis. For this PEIS, the existing environmental conditions within each biome, as well as the BOA and the Atmosphere, were assessed based on several resource areas, as appropriate.

Resource Areas

The resource areas considered in this analysis are those resources that can potentially be affected by implementing the proposed BMDS. Some resource areas are site-specific or local in nature and therefore cannot be effectively analyzed in this type of programmatic document. The potential impacts on these resource areas are more appropriately discussed in subsequent site-specific documentation, tiered from this PEIS. The resource areas analyzed in this PEIS include: air quality, airspace, biological resources, geology and soils, hazardous materials and hazardous waste, health and safety, noise, transportation, and water resources. The MDA has included orbital debris as a resource consideration because of the likelihood of orbital debris occurring from various launch and test activities and its potential for impact to health and safety and the environment.

Other resource areas including cultural resources, environmental justice, land use, socioeconomics, utilities, and visual resources depend upon site-specific or local factors. Each of these was discussed regarding methodology and thresholds for significance to provide the reader with a “roadmap” for performing future site-specific analyses tiering from this PEIS. These discussions outline the types of information that would be needed to conduct site-specific analyses and identify the steps necessary to ensure that potential impacts are thoroughly and appropriately considered.

Environmental Consequences

To determine environmental consequences or impacts of implementing the proposed BMDS, its components (i.e., weapons, sensors, C2BMC, and support assets) were considered as they are developed, tested, deployed and decommissioned during these acquisition life cycle phases. Not all of the activities associated with the proposed BMDS are expected to produce environmental impacts. Only those activities with expected impacts for each life cycle phase are identified. Further, only those activities that are considered reasonably foreseeable are analyzed in this PEIS. BMDS programs that are largely conceptual are not analyzed in this document.

Because of the extensive nature of this project, this PEIS analyzes the BMDS as described in the following four steps.

Step 1 – Identify and Characterize Activities

The BMDS is organized by component (i.e., weapons; sensors; C2BMC; and support assets). Each component has life cycle phase activities associated with developing, testing, deploying, and decommissioning those components within the BMDS. These activities produce environmental impacts, which are examined in this PEIS. To consider impacts of the BMDS, the emissions/stressors from the component life cycle phases were identified and characterized.

Step 2 – Identify Activities with No Potential for Impact

Once the activities were identified, analysis revealed that some of those activities had no potential for (significant) impact. This conclusion was reached because either previous NEPA analysis revealed insignificant impacts, or because the activity was typically categorically excluded. These activities are not further analyzed in this PEIS.

Step 3 – Identify Similar Activities across Life Cycle Phases

The remaining activities with the potential for environmental impacts were then examined to determine which had similar environmental impacts. For example, impacts associated with site preparation and construction in the development phase would be the same as impacts from site preparation and construction activities in the testing and deployment phases of the life cycle. Accordingly many activities were addressed together to eliminate redundancy.

Step 4 – Conduct Environmental Analyses

The final step in the BMDS analysis is to determine the respective impact resulting from the proposed activities. The significance of an impact that an activity has on the environment is a function of the nature of the receiving environment. For example, a booster launch has different emissions than those resulting from activating a chemical laser. Whether those emissions create impacts and the degree of significance of these impacts depends, among other things, upon the environment in which they are released.

In this analysis, the PEIS considers the emissions/stressors from each component's activity in the context of each resource area (e.g., air quality, biological resources, water resources, etc.). Impacts were distinguished based on the different operating environments (land, sea, and air for Alternative 1 and land, sea, air, and space for Alternative 2) in which the activity would occur. These impacts were further distinguished based on the worldwide biomes in which the activity would occur.

As a result, the PEIS is organized by BMDS component, examining each resource area, and distinguishing between operating environments in the context of a particular biome. The analysis describes where the impacts differ based on the operating environment or biome.

Life Cycle Phase Activities

Development phase activities with the potential to produce environmental impacts include site preparation and construction and testing. Both of these activities occur in other life cycle phases for the proposed BMDS, and so the analysis has been combined where appropriate. For example, testing of component prototypes (development phase) has been assumed to cause the same or similar impacts as testing of component test articles (test phase), and so these activities were analyzed as one activity.

Test phase activities were considered in two distinct analyses: one focused on the components and their individual test activities, and the other focused on System Integration Testing which could include multiple components with one or more attempted intercepts to test system capability and effectiveness in increasingly robust and realistic test scenarios.

Component test activities assumed to have potential impacts on the environment were considered for each component as shown in Exhibit ES-5.

Exhibit ES-5. Component Test Activities with Potential Impacts

Component	Activity	Source of Impact	Impacts Analysis
Weapons-Laser	Manufacturing of Test Articles	Manufacturing/assembly of laser components and chemicals	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support laser use/firing	Section 4.1.1.9 Support Assets - Infrastructure

Exhibit ES-5. Component Test Activities with Potential Impacts

Component	Activity	Source of Impact	Impacts Analysis
	Transportation	Transport of the laser and chemicals to appropriate location	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Support Equipment
	Activation	Firing the laser	Section 4.1.1.1 Weapons - Lasers
Weapons-Interceptor	Manufacturing of Test Articles	Manufacturing interceptor components and propellants	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support launch	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of the booster, kill vehicle, and propellants to the launch location	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Prelaunch	Assembly and fueling of the booster or kill vehicle, as appropriate	Section 4.1.1.2 Weapons - Interceptors

Exhibit ES-5. Component Test Activities with Potential Impacts

Component	Activity	Source of Impact	Impacts Analysis
	Launch/Flight	Ignition of rocket motors and flight of boosters or separation of kill vehicle and subsequent flight along its trajectory	Section 4.1.1.2 Weapons - Interceptors
	Postlaunch	Clean up or debris recovery, if required	Section 4.1.1.2 Weapons - Interceptors
Sensors	Manufacturing	Manufacturing/assembly of the sensor hardware and software	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support sensor use	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of the sensor to appropriate location	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Use of the sensor	Sections 4.1.1.3 Sensors - Radar, 4.1.1.4 Sensors - Infrared and Optical, and 4.1.1.5 Sensors - Laser

Exhibit ES-5. Component Test Activities with Potential Impacts

Component	Activity	Source of Impact	Impacts Analysis
C2BMC	Manufacturing	Assembly of associated hardware and software	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modification for computer terminals, antennas, and underground cable trenching	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of C2BMC to appropriate location	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Use of computer terminals, antennas, and underground cable	Sections 4.1.1.6 C2BMC - Computer Terminal and Antennas, 4.1.1.7 C2BMC - Underground Cable
Support Assets-Support Equipment	Manufacturing	New or major modification of existing support equipment	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets

Exhibit ES-5. Component Test Activities with Potential Impacts

Component	Activity	Source of Impact	Impacts Analysis
	Operational Changes	Implementation of new operating parameters of existing support equipment	Section 4.1.1.8 Support Assets - Equipment
	Site Preparation and Construction	New construction or major modification of existing infrastructure	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of support equipment	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
Support Assets-Infrastructure	Site Preparation and Construction	Construction or modification of infrastructure	Section 4.1.1.9 Support Assets - Infrastructure
Support Assets-Test Assets	Manufacturing	Assembly of hardware/software associated with the test sensor	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support the test sensor or launch	Section 4.1.1.9 Support Assets - Infrastructure

Exhibit ES-5. Component Test Activities with Potential Impacts

Component	Activity	Source of Impact	Impacts Analysis
	Transportation	Transport of the sensor, booster and propellants to the test location	Activity categorically excluded or previously analyzed and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Use of the test sensor in a test event	Section 4.1.1.3 Sensors - Radar, 4.1.1.4 Sensors - Infrared and Optical, and 4.1.1.5 Sensors - Laser
	Prelaunch	Assembly and fueling of the booster as appropriate	Section 4.1.1.2 Weapons - Interceptors
	Launch/Flight	Ignition of rocket motors, separation from launch platform, and flight of the boosters or separation of the target object and subsequent flight along its trajectory	Section 4.1.1.2 Weapons - Interceptors
	Use of Countermeasures, Simulants or Drones	Use and deployment of various countermeasures, simulants a or drones to support testing	Section 4.1.1.10 Support Assets - Test Assets
	Postlaunch	Clean up or debris recovery to include launch platform, countermeasures, and simulants, if required	Section 4.1.1.2 Weapons - Interceptors

System Integration Testing of the BMDS would occur at the system level. System Integration Tests evaluate the ability of various component configurations to work together. System Integration Testing would be used to assess the ability of BMDS

components to work interoperably to meet the required functional capabilities of the BMDS as a system and to demonstrate performance. System Integration Tests would integrate existing and planned components such as sensors, weapons, and C2BMC. This PEIS assesses the potential for environmental impacts of integrated BMDS testing under Alternatives 1 and 2. Test integration activities would involve land-, sea-, and air-based operating environments for weapons; and land-, sea-, air- and space-based operating environments for sensors, C2BMC, and support assets for Alternative 1. Assessment of Alternative 2 considers only the additional impacts of the proposed space-based operating environment for interceptors. System Integration Tests with the potential for environmental impacts are shown in Exhibit ES-6.

Exhibit ES-6. Description of System Integration Tests

Test	Activities
Integrated Ground Tests (GTs)	GTs are tests used to collect data for BMDS components characterization and assessment and do not include booster function flight tests. GTs aim to reproduce the existing state of BMDS architecture, typically components scheduled for upcoming flight tests, to prepare for those flight tests and to assess component performance. For the purposes of this PEIS GTs do not include activities associated with components but rather have been focused on System Integration Testing.
System Integration Flight Tests (SIFTs)	SIFTs are conducted to verify the integration of select BMDS components. These tests generally include a target launch, sensors tracking the target, laser activation or an interceptor launch, and sensors to determine whether the target was destroyed. The number of sensors, weapons, and targets used in a SIFT can be adjusted to create the desired test scenario.

The analysis of intercept impacts includes a discussion of the impact of debris from an intercept. Depending on the location used for testing or deployment of weapons, debris may impact either inland or in marine environments. Therefore, impacts from postlaunch activities involving intercepts are subcategorized based on where intercept debris would be likely to impact. For any single intercept, it was assumed that the debris impacts would occur within a single receiving environment, either on land or in water.

Not all test activities would have environmental impacts and MDA has determined that modeling, simulation and analysis; modeling defense integration exercises; and integrated missile defense wargames would not result in significant impacts. These are virtual tests (modeling and computational analysis) or software compatibility and communication tests that would be conducted within existing laboratory or test facilities.

Deployment activities with potential impacts on the environment would include production of the components, site preparation and construction, use of human services, transport of components to the deployment site, testing (prelaunch, launch/flight, activation, postlaunch) and maintenance or sustainment of the components. For purposes of this analysis, the environmental impacts associated with transportation are assumed to be the same as the impacts associated with transporting the components to a test location and the impacts associated with maintenance are assumed to be the same as or similar to the impacts associated with manufacturing activities.

Decommissioning activities would include demilitarization and disposal or replacement of the component, recycling and disposal of hazardous materials. The environmental impacts associated with decommissioning of specific components would be more appropriately addressed in subsequent tiered environmental analyses; however, this PEIS provides a roadmap for considering impacts of decommissioning for each component.

Impacts from accidents and spills are considered where appropriate in this analysis. Specifically, the impacts from booster failures and from spills or releases of laser chemicals, booster propellants, and fuels used to power support assets have been considered. Boosters can fail on or directly above the launch pad or at some point during flight. If a booster fails on or above the pad, there is a potential for damage to infrastructure at and around the launch area. The impact of this type of booster failure is most appropriately addressed in site-specific analysis. If a booster fails during flight, it may be possible to use a Flight Termination System (FTS), if there is one on the vehicle, to destroy the booster. In this instance, the resulting debris would be similar to that produced during an intercept. If an FTS is not used, the booster would fall substantially intact to the surface. The resulting impact from both in-flight failures would depend on the specific location and when in the flight the failure occurred. The quantity of residual propellant released may be greater under a booster failure then during a successful booster flight or intercept. Spills or releases of propellants and fuels would be handled in accordance with standard operating procedures at each facility, range or installation, and therefore, would not be expected to pose significant impacts to the environment.

Cumulative impacts of Alternative 1 and Alternative 2 have been considered in this PEIS. The CEQ NEPA regulations define cumulative impacts as those impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. (40 CFR 1508.7)

Summary of Environmental Impacts – Alternative

This alternative considers the use of land-, sea-, and air-based platforms for BMDS weapons components. Alternative 1 would include space-based sensors, but would not include space-based defensive weapons. A summary of potential environmental effects

from Alternative 1 is provided by subcomponent in Exhibits ES-7 through ES-10. The summary tables are organized by component and subcomponent. The analyses are specific to each resource area based on the impacts from the activities associated with the subcomponent. The impacts associated with the manufacturing, site preparation and construction, and transportation activities of components are discussed under Support Assets.

Exhibit ES-7. Summary of Environmental Impacts of Alternative 1 - Weapons

Resource Area	Lasers	Interceptors
Air Quality	Emissions from laser operation (less than 30 seconds) would be minimal and would be dispersed by wind and would not significantly affect local or regional air quality.	Negligible amounts of fuel and oxidizer vapors might be released during propellant transfers. Most launch emissions would be dispersed by wind and would not significantly affect local or regional air quality or ozone depletion.
Airspace	Following required scheduling and coordination procedures would minimize the potential for adverse impacts to airspace.	Following required scheduling and coordination procedures would minimize potential for adverse impacts to airspace.
Biological Resources	Emissions, noise, and the laser beam from laser activation could negatively impact biological resources. Emitted chlorine might damage vegetation; hydrogen chloride (HCl) might irritate birds flying through the exhaust cloud or reach and disrupt aquatic ecosystems. Wildlife could be startled by noise from laser support equipment. The laser beam could pose fire hazards to vegetation and eye and skin hazards to wildlife. However, impacts to these resources would be minimal if the beam is contained or directed upward.	The presence of launch-related personnel prior to launch, launch noise, and launch emissions could impact biological resources during launch; however, launches are relatively infrequent and would not be expected to significantly impact wildlife. Debris impacting water has the potential to cause non-acoustic effects to biological resources from physical impact from falling debris, entanglement in debris, and contact with or ingestion of debris or propellants. However, these effects would not significantly impact biological resources.
Geology and Soils	Soil acidity might be affected as a result of chlorine emissions from laser activation. Magnitude of impact would be related to the amount of limestone in the soils. However, chlorine emissions are small and laser activation relatively infrequent and the impacts to geology and soils would not be significant.	Potential impacts would not be significant. Launch emissions that occur above the mixing height or above the troposphere would not cause impacts. Soil acidity might be affected as a result of HCl emissions from some launch activities. Magnitude of impact would be related to the amount of limestone in the soils. Debris from boosters and kill vehicles could hit and affect the surface and soils where they impact, but there would be no significant impact on geology.
Hazardous Materials and Hazardous Waste	Spent laser chemicals and wastewater would be treated and disposed in accordance with applicable transport and management regulations to prevent impacts. Therefore, no significant impacts from hazardous materials or hazardous waste would be expected.	Applicable regulations and operating procedures would be followed and would prevent impacts from improper transport, management, or disposal of hazardous materials or hazardous waste.
Health and Safety	Following spill prevention and control procedures would reduce potential health and safety impacts from accidental releases of laser chemicals. Hazard distances would be established to protect against skin or eye hazards from the laser beam and inhalation hazards from air emissions; therefore, no significant health and safety impacts would be expected.	Potential health and safety impacts include exposure to explosives, contact with launch debris, and exposure to launch noise. Launches would take place on facilities with restricted access, preventing exposure of the public to these hazards. Following appropriate procedures during fueling and prelaunch operations would reduce potential impacts. On-site personnel would be protected from launch event hazards; therefore, no significant health and safety impacts would be expected.

Exhibit ES-7. Summary of Environmental Impacts of Alternative 1 - Weapons

Resource Area	Lasers	Interceptors
Noise	The public would be excluded from areas where noise from operational equipment would be detrimental and workers would use recommended hearing protection. Therefore, no significant noise impacts would be expected.	The launch and flight of boosters would produce launch noise and sonic booms. The public would not be in proximity to launch sites and therefore would not be exposed to significant noise levels. Launch personnel would either leave the area or wear recommended hearing protection. Therefore, no significant noise impacts would be expected.
Transportation	Air traffic might be impacted by laser activation. Following required scheduling and coordination procedures would minimize the potential for adverse impacts. No significant impacts would be expected to other transportation modes.	Impacts on traffic due to temporary road closures are not expected to be significant. Notices to Airmen (NOTAMs) and Notices to Mariner (NOTMARs) would provide sufficient warning to prevent significant impacts to air and marine transportation.
Water Resources	Some emissions from laser activation have the potential to temporarily and locally increase the acidity of surface waters. However, these emissions would be diluted and dispersed by receiving waters. Therefore, no significant water resource impacts would be expected.	Following appropriate procedures during fueling operations would reduce the potential for propellants to impact water resources. Some emissions from launches could temporarily and locally increase acidity of surface waters. However, these emissions would be diluted and dispersed by receiving waters and would not be expected to pose significant impacts to water resources.
Orbital Debris	N/A	Debris created from a booster failure while operating in the exoatmosphere would reenter Earth's atmosphere within a few months. Because the debris would be on orbit for a relatively short time it would not have a significant impact on orbiting structures. In addition, only a small amount of debris would survive reentry and therefore no significant impacts are expected.

Exhibit ES-8. Summary of Environmental Impacts of Alternative 1 - Sensors

Resource Area	Radars	Infrared and Optical Sensors	Laser Sensors
Air Quality	Emissions from radars would be limited to generator exhaust, which are considered in Support Assets.	Emissions from infrared and optical sensors would be limited to generator exhaust, which are considered in Support Assets.	Gas laser sensors would use inert gases, e.g., helium, nitrogen (N_2), and carbon dioxide (CO_2), which can be asphyxiants. Leaks of these gases would be insignificant relative to ambient oxygen levels; therefore no significant air quality impacts would be expected.
Airspace	NOTAMs would be issued and pilots would be restricted from electromagnetic radiation (EMR) hazard areas during radar activation. Restrictions would be short term and would not significantly impact airspace.	Activation of infrared and optical sensors would not interfere with airspace; therefore, no impacts to airspace would be expected.	Ground testing of laser sensors would be conducted in an established controlled firing area. Activation of laser sensors from air platforms would occur at an upward angle above commercial aircraft traffic. Therefore, no significant airspace impacts would be expected.
Biological Resources	There may be some risk of thermal heating to birds from the COBRA DANE radar as discussed in Appendix N, Impacts of Radar on Wildlife. However, MDA has proposed mitigation measures such as limiting the use of the radar during migratory seasons and when flocks may be in the vicinity. Therefore, no significant biological resource impacts would be expected.	Activation of infrared and optical sensors would not interfere with biological resources; therefore, no significant biological resource impacts would be expected.	Birds and mammals in the laser beam path could suffer eye damage. The short duration of laser activation and small range area would minimize impacts. Direction of laser sensor beams from space platforms towards the Earth's surface, would suffer distortion from atmospheric conditions reducing the radiance level of the lasers. Therefore, no significant impacts to biological resources would be expected.
Geology and Soils	Impacts would be limited to accidental spills of diesel fuel or coolants from support generators, which are considered in Support Assets.	Impacts would be limited to accidental spills of diesel fuel or coolants from support generators, which are considered in Support Assets.	Activation of laser sensors would not impact geology and soils.
Hazardous Materials and Hazardous Waste	Applicable regulations and procedures would be followed and would minimize impacts from management of hazardous materials or waste.	Applicable regulations and procedures would be followed and would minimize impacts from management of hazardous materials or waste.	Refrigerant 404, an ozone-depleting substance, may be used to cool some laser sensors. These would be closed loop systems, with replacement of refrigerant only during routine maintenance performed according to applicable regulations, therefore, no significant impacts from hazardous materials or waste management would be expected.

Exhibit ES-8. Summary of Environmental Impacts of Alternative 1 - Sensors

Resource Area	Radars	Infrared and Optical Sensors	Laser Sensors
Health and Safety	Prior to activation of radars, an EMR survey would be conducted to consider hazards to personnel, fuels, and ordnance. Resulting recommendations would establish safety exclusion zones to minimize exposures. Safety exclusion zones would also be established to minimize high voltage exposure from generator wiring and cabling. Therefore, no significant health and safety impacts would be expected.	Activation of infrared and optical sensors would not impact health and safety. Safety exclusion zones would be established as required to minimize high voltage exposure from generator wiring and cabling.	Sensor laser beams can be hazardous to the eyes of living organisms within a certain hazard distance. Applicable regulations and procedures, such as establishing restricted areas, displaying warning signs, designating restricted areas, and removing reflective surfaces, would reduce potential health and safety impacts below significant levels. Safety exclusion zones would also be established to minimize high voltage exposure from generator wiring and cabling.
Noise	Noise impacts would be limited to noise produced by generators, which are considered in Support Assets.	Noise impacts would be limited to noise produced by generators, which are considered in Support Assets.	Noise impacts would be limited to noise produced by generators, which are considered in Support Assets.
Transportation	NOTAMs and NOTMARs would provide sufficient warning. Therefore, no significant transportation impacts would be expected.	Activation of infrared and optical sensors would not interfere with transportation. Therefore, no significant transportation impacts would be expected.	Activation of laser sensors would not interfere with transportation. Therefore, no significant transportation impacts would be expected.
Water Resources	Releases of diesel fuel or coolants from support generators into surface water would be diluted rapidly; therefore, no significant impacts to water resources would be expected.	Releases of diesel fuel or coolants from support generators into surface water would be diluted rapidly; therefore, no significant impacts to water resources would be expected.	Liquids used in laser sensor cooling systems are non-hazardous and in the unlikely event of a release would not be expected to impact water resources.
Orbital Debris	Space-based radars could reenter the Earth's atmosphere due to failure; however, most objects break up and vaporize in the upper atmosphere under intense forces and heating during reentry. Even if an object survives reentry, it would most likely land in an ocean area, and the chance of hitting populated land area would be small. Therefore, no significant orbital debris impacts would be expected.	Space-based infrared and optical sensors could reenter the Earth's atmosphere due to failure; however, most objects break up and vaporize in the upper atmosphere under intense forces and heating during reentry. Even if an object survives reentry, it would most likely land in an ocean area, and the chance of hitting populated land area would be small. Therefore, no significant orbital debris impacts would be expected.	Space-based laser sensors could reenter the Earth's atmosphere due to failure; however, most objects break up and vaporize in the upper atmosphere under intense forces and heating during reentry. Even if an object survives reentry, it would most likely land in an ocean area, and the chance of hitting populated land area would be small. Therefore, no significant orbital debris impacts would be expected.

Exhibit ES-9. Summary of Environmental Impacts of Alternative 1 - C2BMC

Resource Area	Computer Terminals and Antennas	Underground Cable
Air Quality	Activation emissions would be limited to generator exhaust. Impacts from generator emissions are considered in Support Assets.	Impacts would be limited to ground disturbances resulting from construction activities. Impacts from ground disturbance are considered in Support Assets.
Airspace	Radio transmission frequencies used by computer terminals and antennas could impact airspace through interference with commercial air traffic control communications. Radio frequency use and testing would be coordinated with the appropriate air traffic control agencies; therefore, no significant airspace impacts would be expected.	Activation of underground cable would not interfere with airspace; therefore, no significant airspace impacts would be expected.
Biological Resources	Biological resources could be impacted by activation activities, but the level of impact would vary based on signal frequency and energy, and the proximity of the source to sensitive environments or specific threatened or endangered species. Radio frequency use and testing would be coordinated with the appropriate resource management agencies; therefore, no significant biological resource impacts would be expected.	Activation of underground cable would not interfere with biological resources. Therefore, no significant biological resource impacts would be expected.
Geology and Soils	Activation of computer terminals and antennas would not interfere with geology and soils. Therefore, no significant geology and soils impacts would be expected.	Impacts to geology and soils would be limited to site preparation activities. Impacts from ground disturbance are considered in Support Assets.
Hazardous Materials and Hazardous Waste	Any hazardous materials or wastes used or generated would be handled in accordance with appropriate regulations. Therefore, no significant hazardous materials and hazardous waste impacts would be expected.	Impacts from hazardous materials and hazardous wastes would be limited to site preparation activities. Impacts from ground disturbance are considered in Support Assets.
Health and Safety	Health and safety impacts would vary based on signal frequency and energy, and the proximity of the source to site personnel or the public. No significant health and safety impacts would be expected.	Potential health and safety hazards would be limited to dust/particulate inhalation, improper chemical handling, and improper use of machinery during site preparation and construction. Impacts from ground disturbance are discussed in Support Assets.
Noise	Noise impacts associated with activation of computer terminals and antennas would be limited to noise produced by generators. Impacts related to generator noise are discussed in Support Assets.	The activation of underground cable would not produce noise that has the potential to impact sensitive receptors.
Transportation	Personnel operating and maintaining computer terminals and antennas would generate traffic as a result of activation. Personnel would be on site only during operating hours and during routine maintenance activities; therefore, no significant transportation impacts would be expected.	Any necessary repairs to underground cable would require excavation of the cable. These activities could result in impacts to transportation through movement of equipment and personnel to the repair site. However, this would occur infrequently, therefore, impacts to transportation would not be significant.

Exhibit ES-9. Summary of Environmental Impacts of Alternative 1 - C2BMC

Resource Area	Computer Terminals and Antennas	Underground Cable
Water Resources	Activation of computer terminals and antennas would not interfere with water resources. Therefore, no significant impacts would be expected.	Impacts to water resources might result from site preparation activities. Impacts from ground disturbance are considered in Support Assets.
Orbital Debris	Space-based computer equipment could reenter the Earth's atmosphere due to failure, but no significant orbital debris impacts would be expected.	N/A

Exhibit ES-10. Summary of Environmental Impacts of Alternative 1 – Support Assets

Resource Area	Support Equipment	Infrastructure	Test Assets
Air Quality	Increased use of support equipment resulting in greater quantities of emissions could impact air quality. The significance of the impact depends on the local and regional regulatory setting and the physical climate where emissions would occur.	Site preparation and construction activities would result in air emissions; however, it is assumed that the impact on air quality would be temporary and localized. Therefore, no significant air quality impacts would be expected.	The development and use of targets, simulants, countermeasures, and drones could impact air quality. Following standard operating procedures would reduce potential impacts to air quality below significant levels.
Airspace	Operational use changes of support assets would not interfere with airspace. Increases in support asset operations would be in accordance with existing airspace use regulations. Therefore, no significant airspace impacts would be expected.	Site preparation and construction would not interfere with airspace. Therefore, no significant airspace impacts would be expected.	Simulants, countermeasures, and their delivery systems (boosters) could impact airspace. Site-specific analyses would be conducted to address these potential impacts.
Biological Resources	Following required scheduling, duration of testing, and completing required agency regulatory agency consultations would reduce potential impacts on biological resources below significant levels.	Site preparation and construction activities could impact biological resources. Site-specific analyses and regulatory agency consultations would be conducted to address these potential impacts.	Potential impacts on biological resources could be associated with debris in which simulants and countermeasures were used. Site-specific analysis would be conducted to address these potential impacts.
Geology and Soils	In general, operational use changes would not be expected to significantly impact geology and soils. Mitigation measures may be used in instances where impacts could occur to reduce impacts to less than significant levels.	Construction would incorporate design parameters consistent with the geologic setting to reduce potential seismic impacts. Construction activities could impact soils; however, Best Management Practices would be implemented to minimize impacts.	Development and use of simulants and countermeasures could impact soils based on the composition of the simulant or countermeasure. Site-specific analyses would be conducted to address potential impacts.
Hazardous Materials and Hazardous Waste	Hazardous waste would be handled and disposed in accordance with appropriate regulations. Therefore, no significant hazardous materials and hazardous waste impacts would be expected.	Hazardous waste would be handled and disposed in accordance with appropriate regulations. Therefore, no significant hazardous materials and hazardous waste impacts would be expected.	Hazardous waste would be handled and disposed in accordance with appropriate regulations. Therefore, no significant hazardous materials and hazardous waste impacts would be expected.
Health and Safety	Standard operating procedures specific to an action or installation would be used and equipment training performed to reduce potential impacts to health and safety.	Standard operating procedures specific to an action or installation would be used and equipment training performed to reduce potential impacts to health and safety.	Standard operating procedures specific to an action or installation would be used and equipment training performed to reduce potential impacts to health and safety.

Exhibit ES-10. Summary of Environmental Impacts of Alternative 1 – Support Assets

Resource Area	Support Equipment	Infrastructure	Test Assets
	Therefore, no significant health and safety impacts would be expected.	Therefore, no significant health and safety impacts would be expected.	Therefore, no significant health and safety impacts would be expected.
Noise	Noise impacts are based on site-specific receptors and are regulated on a regional basis. Site-specific analysis would be conducted for actions that may have noise impacts.	Noise impacts are based on site-specific receptors and are regulated on a regional basis. Site-specific analysis would be conducted for actions that may have noise impacts.	The development and use of simulants or countermeasures would not have noise impacts. The launch and flight of targets would produce noise similar to that of interceptors. However, as described in Exhibit ES-6 no significant noise impacts would be expected.
Transportation	Operational use changes that increase the amount of time that support equipment are used could impact transportation. However, these impacts are not expected to be significant.	Site preparation and construction activities may require the use of heavy machinery and an influx of construction workers which could change the congestion and level of demand for access to the existing roadways. However, these activities would not be expected to cause a significant impact on transportation.	The development and the use of simulants would not impact transportation. Short-term road closures, the issuance of NOTAMs and NOTMARs to notify pilots and mariners of area closures, and debris recovery activities would not be expected to impact transportation.
Water Resources	Operational use changes occurring at existing facilities designed for the support equipment would not impact water resources. Operational use changes that result in impacts to areas not specifically designed for use of the support equipment could be subject to additional environmental review.	Applicable protocols and permits would reduce potential impacts to water resources from construction activities to below significant levels. Site-specific analyses would be conducted for new installations.	The development and use of simulants and countermeasures could impact water resources. Site-specific analyses would be conducted to determine and address impacts.
Orbital Debris	No impacts from orbital debris would occur as a result of the development of new or the major modification of existing equipment or an operational use change of such equipment. Space-based equipment (satellites) could reenter the Earth's atmosphere due to failure, but would not likely result in significant impacts because they would burn up on reentry.	No impacts from orbital debris would occur as a result of the development of new or the major modification of existing infrastructure.	If countermeasures are used and remain on-orbit, they have the potential to disrupt or damage space-based assets (e.g., communication satellites). However, because the debris would be on orbit for a relatively short time it would not have a significant impact on orbiting structures. In addition, only a small amount of debris would survive reentry and therefore no significant impacts are expected.

Test Integration

System Integration Tests would integrate existing and planned components such as sensors, weapons, and C2BMC. Under Alternative 1, test integration activities would involve land-, sea-, and air-based platforms for weapons; and land-, sea-, air- and space-based platforms for sensors, C2BMC, and support assets. Integrated GTs and SIFTs have the potential for environmental impacts, as described in Exhibit ES-6.

For this PEIS, two representative scenarios that could be used during SIFTs were considered for Alternative 1. These two representative scenarios involve similar activities (launches of targets, use of multiple sensors, and use of land-, sea-, and air-based weapons); however, they differ in number of target launches and number of weapons used. Both representative scenarios may be used to support the proposed BMDS and are analyzed in this PEIS. The activities associated with each type of System Integration Tests that were analyzed in this PEIS include

- **Integrated GTs**. The activation of multiple sensors and C2BMC components, and passive activation of weapons (e.g., powering the tracking and communication aspects of the weapons system but not firing the weapon) within the same biome or across several biomes, which would coordinate the control and transfer of information between land-, sea-, and air-based weapons.

- **SIFT Scenario 1- Single Weapon with Intercept**. The activation of multiple sensors and C2BMC components within the same biome or across several biomes coupled with the launch of one target and the activation of a laser or launch of an interceptor, and the debris from an intercept.

- **SIFT Scenario 2- Multiple Weapons with Multiple Intercepts**. The activation of multiple sensors and C2BMC components within the same biome or across several biomes coupled with the launch of up to two targets from the same biome or different biomes, the activation or launch of multiple weapons in the same biome or multiple biomes, and the debris from intercepts.

A summary of potential environmental effects associated with Test Integration for Alternative 1 is provided in Exhibit ES-11. The analyses are specific to each resource area based on the impacts from the activities associated with each test.

Exhibit ES-11. Summary of Environmental Impacts of Alternative 1 - Test Integration

Resource Area	GT	SIFT Scenario 1	SIFT Scenario 2
Air Quality	Emissions from generators used to power sensors and C2BMC would be a small fraction of the *de minimis* threshold and would not impact air quality. The activation of radars, infrared, and optical sensors would not impact air quality.	Emissions from launch activities and laser activation would be less than two percent of *de minimis* thresholds; impacts to air quality would be insignificant.	Impacts to air quality would be insignificant, provided the activity is within parameters of the launch facility or range.
Airspace	Coordination with the FAA Air Route Traffic Control Center (ARTCC), military installations, and foreign countries with jurisdiction over affected airspace would minimize the potential for impact. All laser sensors would be operated using appropriate range safety regulations.	Close coordination with the FAA ARTCC, military installations, and foreign countries with jurisdiction for airspace management would minimize the potential for adverse impacts on airspace use and scheduling. Upon completion of such coordination for each test, there would be no significant impacts to airspace.	Close coordination with the FAA ARTCC, military installations, and foreign countries with jurisdiction over affected airspace would reduce the potential impacts to airspace. Upon completion of such coordination for each test, there would be no significant impacts to airspace.
Biological Resources	Potential impacts to the environment and the threatened and endangered species, the unique or sensitive environments, and the migratory, breeding, and feeding activities would be evaluated in site-specific analyses.	Potential impacts to the environment and the threatened and endangered species, the unique or sensitive environments, and the migratory, breeding, and feeding activities would be evaluated in site-specific analyses.	Potential impacts to the environment and the threatened and endangered species, the unique or sensitive environments, and the migratory, breeding, and feeding activities would be evaluated in site-specific analyses.
Geology and Soils	Fuel spills associated with generators would be controlled and cleaned up according to appropriate procedures; therefore any impacts would be insignificant.	HCl and particulate emissions from interceptor and target launches would not result in significant impacts to geology and soils.	HCl and particulate emissions from interceptor and target launches would not result in significant impacts to geology and soils.
Hazardous Materials and Hazardous Waste	Hazardous materials and waste would be handled according to all applicable regulations, and each test location would have a Spill Prevention, Control and Countermeasure (SPCC) plan in place to handle any spills or leaks of hazardous materials; therefore impacts would be insignificant.	Applicable regulations and procedures would be followed and would prevent impacts from management and disposal of hazardous materials or waste associated with laser activation and target and weapons launches.	Applicable regulations and procedures would be followed and would prevent impacts from management and disposal of hazardous materials or waste associated with laser activation and target and weapons launches.
Health and Safety	All safety procedures would be followed, safety zones would be established, and participating personnel would be trained	All safety procedures would be followed, safety zones would be established, and participating personnel would be trained and certified to reduce the potential for impacts to	All safety procedures would be followed, safety zones would be established, and participating personnel would be trained and certified to reduce the potential for impacts to

Exhibit ES-11. Summary of Environmental Impacts of Alternative 1 - Test Integration

Resource Area	GT	SIFT Scenario 1	SIFT Scenario 2
	and certified to reduce the potential for impacts to health and safety.	health and safety associated with launches of targets and weapons.	health and safety associated with launches of targets and weapons. The increased exposure to health and safety risks associated with SIFT Scenario 2 would not be expected to result in a significant impact.
Noise	Generators would be operated during tests, and sea- and air-based systems typically would not be operated in proximity to sensitive receptors. In general, the increase in noise from multiple generator use within an environment would not be significant.	Noise from launches of targets and weapons and sonic booms would occur in areas away from sensitive receptors, and would not result in significant impacts.	Noise from launches of targets and weapons and sonic booms would occur in areas away from sensitive receptors, and would not result in significant impacts.
Transportation	NOTAMs and NOTMARs would be issued in advance of testing events to allow aircraft and vessels to plan alternate routes to avoid the EMR hazard areas; the impacts would be insignificant.	Closures of roads, airspace, and marine areas would be of short duration and would be considered routine occurrences for launch sites, and issuance of NOTAMs and NOTMARs would allow vehicles to clear the affected areas. Impacts to transportation would be insignificant.	The increase in transportation requirements or any increases in the frequency, duration, or number of transport route closures would not result in a significant transportation impact.
Water Resources	In general, an increase in risk from hazardous materials and hazardous waste spills and an increase in demand for potable water would not result in significant impacts.	Impacts from the deposition of emissions, propellants, and debris into water resources would be dependent on the specific biome and the unique and sensitive water resources that occur in the biome. In general, impacts to water resources from laser activation and launches would not have additive impacts for activities occurring within the same biome.	Site-specific environmental analysis would be completed to evaluate potentially significant impacts. In general, impacts to water resources from laser activation and launches would not have additive impacts for activities occurring within the same biome.

Exhibit ES-11. Summary of Environmental Impacts of Alternative 1 - Test Integration

Resource Area	GT	SIFT Scenario 1	SIFT Scenario 2
Orbital Debris	N/A	Debris created from exoatmospheric intercepts would reenter Earth's atmosphere within a few months. Because the debris would be on orbit for a relatively short time it would not have a significant impact on orbiting structures. In addition, only a small amount of debris would survive reentry and therefore no significant impacts are expected.	Debris created from exoatmospheric intercepts would reenter Earth's atmosphere within a few months. Because the debris would be on orbit for a relatively short time it would not have a significant impact on orbiting structures. In addition, only a small amount of debris would survive reentry and therefore no significant impacts are expected.

Cumulative Impacts

The implementation of the proposed BMDS under Alternative 1 is worldwide in scope and potential application, and only other actions that are international in scope, have been considered for cumulative impacts. Regional or local past, present, or future actions, which may result in cumulative impacts, would be considered during the completion of site-specific NEPA analyses. Worldwide launch programs for commercial and government programs were determined to be actions of international scope that might be reasonably considered for cumulative impacts in this PEIS. Launches contribute to cumulative impacts in areas including ozone depletion, global warming, and orbital debris.

The cumulative impact on stratospheric ozone depletion from BMDS launches would be far less than and indistinguishable from the effects caused by other natural and man-made sources. The estimated emission loads of chlorine from both BMDS and worldwide launches from 2004 to 2014 would account for only 0.5 percent of the industrial chlorine load from the U.S. over the same 10-year period. Therefore, the cumulative impacts to ozone depletion would not be significant.

The cumulative impact on global warming from BMDS launches from 2004 to 2014 would be insignificant compared to other industrial sources (e.g., energy generation using fossil fuel) and activities (e.g., deforestation and land clearing). The BMDS launch emissions load of carbon monoxide (CO) and CO_2 to the troposphere and stratosphere would be only five percent of the emissions load from worldwide launches. However, even when accounting for both BMDS launches and worldwide launches over the 10-year period, the CO and CO_2 load is extremely small compared to emissions loads from other industrial sources, accounting for 3.5×10^{-4} percent of emissions from U.S. industrial sources in just one year. Therefore, the cumulative impacts to global warming would not be significant.

Orbital debris could be produced from BMDS space-based sensors. Orbital debris that remains on orbit could create hazards to orbiting spacecraft and could have impacts upon reentry if the debris reaches the Earth's surface in large pieces or containing hazardous materials.

Successful flight tests of the BMDS in the exoatmosphere would result in kinetic energy (i.e., hit-to-kill) intercepts that would produce both target and interceptor debris clouds. With the need for increasingly realistic test scenarios, MDA is considering high altitude, high velocity intercept tests. MDA analysis of BMDS flight tests employing ground-launched interceptors shows that the majority (90 to 95 percent) of post-intercept debris reenters the Earth's atmosphere within six hours. A small amount of post-intercept debris may become orbital debris; however, modeling indicates that risk to spacecraft from intercept debris is far lower than the risk posed by existing background debris.

Additional efforts are on-going to determine flight test risks in the space environment and resulting potential impacts on orbiting spacecraft.

The effects of orbital debris on other spacecraft would depend on the altitude, orbit, velocity, angle of impact, and mass of the debris. Debris less than 0.01 centimeter (0.004 inch) in diameter can cause surface pitting and erosion. Debris between 0.01 to 1 centimeter (0.004 and 0.4 inch) in diameter would produce significant impact damage that can be serious, depending on system vulnerability and defensive design provisions. Objects larger than one centimeter (0.4 inch) in diameter can produce catastrophic damage.

Astronauts or cosmonauts engaging in extra-vehicular activities could be vulnerable to the impact of small debris. On average, debris one millimeter (0. 04 inch) is capable of perforating current U.S. space suits.

Proposed BMDS space-based sensor activities would be expected to produce small quantities of orbital debris, primarily explosive bolts and small pieces of hardware. MDA exoatmospheric flight testing may also produce orbital debris. However, because the majority of BMDS activities would occur in Low Earth Orbit (LEO) where debris would gradually drop into successively lower orbits and eventually reenter the atmosphere, the debris would not be a permanent hazard to orbiting spacecraft. As BMDS testing becomes more realistic, there is potential for an increased amount of debris reaching and remaining on orbit. A large portion of this debris would likely not remain on orbit for more than one revolution, and eventually all of the debris would be expected to de-orbit.

Although it cannot be determined with certainty how much orbital debris would be produced from BMDS space-based sensors or intercepts annually, the fact that orbital debris reenters the Earth’s atmosphere on a daily basis, and that this debris has not caused injury or significant property damage on Earth indicates that orbital debris produced by BMDS space-based sensors and potential exoatmospheric intercepts would not pose significant impacts upon reentry. Therefore the cumulative impacts of orbital debris from Alternative 1 are not expected to be significant.

Summary of Environmental Impacts - Alternative 2

This alternative includes the use of interceptors from land-, sea-, air-, and space-based platforms. The impacts associated with the use of interceptors from land, sea, and air platforms would be the same as those discussed for Alternative 1. Therefore, the analysis for Alternative 2 focuses on the impacts of using interceptors from space-based platforms. At this time although MDA has historically conducted research and development efforts on space-based lasers, these efforts have been put on hold as kinetic energy missile technology, which is more promising in the short term, is being pursued.

If Alternative 2 were selected, additional environmental analysis would be required as the technologies intended to be used become more robust. For purposes of impacts analysis for space-based interceptors it was assumed that all manufacturing activities impacts would be the same as those discussed for Alternative 1, therefore, they are not discussed in detail for Alternative 2. Space-based interceptors would be launched on launch vehicles and maintained from platforms similar to other satellites used for DoD and commercial purposes in prescribed orbits around the Earth. The launch vehicles used to insert the weapon platforms into the proper orbit would likely be existing launch vehicles; and therefore, the impacts of the launch would be as described for support assets. A summary of potential environmental effects from Alternative 2 is provided in Exhibit ES-12.

Exhibit ES-12. Summary of Environmental Impacts of Alternative 2 – Weapons[2]

Resource Area	Interceptors	Debris
Air Quality	Emissions from space-based launches would not affect the human environment; therefore, no significant air quality impacts would be expected.	Most space-based interceptors and associated platform debris would be destroyed upon reentry. Some small particles and pieces of debris may serve as reaction sites for chemical reactions in the atmosphere. Due to the infrequency of debris reentry and deorbiting events, no significant air quality impacts would be expected.
Airspace	A space-based interceptor may be directed towards the Earth during intercepts and could impact the use of airspace in the interceptor's designated path. Coordination with the appropriate FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impacts to airspace use. Therefore, no significant airspace impacts would be expected.	For controlled reentries, affected portions of airspace would be cleared of aircraft. For uncontrolled reentries, current capabilities and procedures provide a limited ability to predict when and where a particular object would reenter the Earth's atmosphere. Little advance warning could be given to clear airspace in the event of an uncontrolled reentry. However, uncontrolled reentry would occur infrequently and therefore, no significant airspace impacts would be expected.
Biological Resources	Trajectories would be carefully selected such that interceptor debris would impact in a cleared portion of the ocean or military range. It is unlikely that any interceptor debris that survives reentry would impact biological resources and no significant impacts would be expected.	Most interceptor and platform debris would be destroyed upon reentry. The debris would fall to the Earth's surface and likely terminate in open ocean waters, where impact would be limited to animals in the immediate surface waters near the impact point. Fish and marine mammals at lower depths of the ocean would have more time to react to the sound and would be able to avoid the impact area. Therefore, no significant biological resource impacts would be expected.
Geology and Soils	The launch of interceptors from space-based platforms would not impact geology and soils.	Most debris from space-based interceptors or platforms would likely not survive reentry; surviving debris would likely be very small in size. Therefore, no significant impacts would be expected to geology and soils from space-based debris.
Hazardous Materials and Hazardous Waste	The launch/flight of space-based interceptors would not produce hazardous waste that would be transported to or disposed of on Earth. Therefore, no significant hazardous material and waste impacts would be expected.	Debris contaminated with hazardous materials would be exposed to high temperatures during reentry, likely rendering the debris inert by the time it reaches the Earth's surface. Debris and deorbited material would not be considered hazardous waste. Therefore, no significant hazardous materials or waste impacts would be expected.

[2] Impacts from Alternative 2 include impacts analyzed under Alternative 1 with the addition of space-based weapons.

Exhibit ES-12. Summary of Environmental Impacts of Alternative 2 – Weapons[2]

Resource Area	Interceptors	Debris
Health and Safety	Trajectories would be selected such that, in the event of an unsuccessful intercept attempt, interceptor debris would impact in the open ocean or in designated land-based areas, which would reduce the potential for impacts to health and safety. Therefore, no significant health and safety impacts would be expected.	Trajectories would be selected such that debris would impact in the open ocean or in designated land-based areas. In the event of an uncontrolled deorbit, debris might hit and injure humans. However, the risk that an individual would be hit and injured by reentering orbital debris is estimated to be less than one in one trillion. Therefore, no significant health and safety impacts would be expected.
Noise	Launch noise from space-based launches would not be audible in the human environment and therefore, no significant impacts would be expected.	The noise produced by large pieces of debris hitting the Earth's surface might cause startle responses in nearby animals and might displace mobile species for a short time. However, as reentering debris would generally be small in size, no significant noise impacts would be expected.
Transportation	Launches from space-based platforms would not impact transportation.	Debris reaching the open ocean would most likely not be recovered. Debris recovery on land would be as described for Alternative 1, and would not have an impact on transportation.
Water Resources	Launches from space-based platforms would not impact water resources.	Debris would be rendered inert due to the high temperatures during reentry. Thus debris impacting in surface water would not impact water resources.

Test Integration

System Integration Tests would integrate existing and planned components such as sensors, weapons, C2BMC, and support assets. Under Alternative 2, System Integration Tests would involve land-, sea-, air-, and space-based platforms for weapons; and land-, sea-, air- and space-based platforms for sensors, C2BMC, and support assets.

The unique activities associated with each type of System Integration Test analyzed in this PEIS under Alternative 2 include

- **Integrated GT**. The use of additional components to control and coordinate the activities of the four weapon platforms (land-, sea-, air-, and space-based).

- **SIFT Scenario 1 – Single Weapon with Intercept**. The launch of interceptors from space-based platforms with an intercept.

- **SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts**. The launch of multiple interceptors from multiple weapon platforms (land-, sea-, air-, and space-based) at up to two targets with intercepts. Under Alternative 2, the analysis assumes that the launch of a space-based interceptor would replace a land-, sea-, or air-based weapon launch or laser activation.

A summary of potential environmental effects associated with Test Integration for Alternative 2 is provided in Exhibit ES-13. The analyses are specific to each resource area based on the impacts from the activities associated with each test.

Exhibit ES-13. Summary of Environmental Impacts of Alternative 2 - Test Integration

Resource Area	SIFT Scenario 2[3]
Air Quality	If an interceptor launch from a space-based weapon replaced an interceptor launch from a land- or sea-based weapon, a reduction in ground level emissions would occur. If the activation of an air-based weapon were replaced, then a reduction in emissions would occur in the upper atmosphere. Impacts to air quality would be less than those for Alternative 1.
Airspace	If the flight path of a space-based weapon is limited to the exoatmosphere, then the impacts to airspace would be less than those for Alternative 1. If the flight path of a space-based weapon is directed toward Earth in the endoatmosphere, then the impacts to airspace would be similar to those for Alternative 1.
Biological Resources	Interceptor launches from space-based weapons would result in fewer impacts on Earth from noise and pollutant emissions. The impacts to biological resources for Alternative 2 would be less than those for Alternative 1.
Geology and Soils	If a land-based launch is replaced by a space-based launch, then the impacts to geology and soils would be less for Alternative 2 than those for Alternative 1. If a sea- or air-based launch is replaced by a space-based launch, then the impacts to airspace would be similar to those for Alternative 1.
Hazardous Materials and Hazardous Waste	Under Alternative 2, there would be a reduction of hazardous materials use, and hazardous waste generation associated with the launch or activation of a weapon. The impacts from hazardous materials and hazardous wastes for Alternative 2 would be less than those for Alternative 1.
Health and Safety	Launching an interceptor from space rather than from land, air, or sea would result in a reduction in the number of individuals that would be exposed to health and safety risks associated with launch activities. Because no significant impacts were identified under Alternative 1 from the increased use and generation of hazardous materials and hazardous waste, no significant impacts would be expected from Alternative 2.
Noise	Noise produced from the launch of interceptors from space-based platforms would not be audible on Earth. Because no significant impacts were identified under Alternative 1 from increased noise, no significant impacts would be expected from Alternative 2.
Transportation	The transportation impacts under Alternative 2 would be the same as the impacts under Alternative 1.
Water Resources	An interceptor launch from a space-based platform would replace an interceptor launch from a land-, sea-, or air-based platform, which would result in a potential reduction in the debris and simulants that would reach a water resource based on elevation where an intercept or flight termination would occur. Impacts to water resources for Alternative 2 would be less than or equal to those for Alternative 1.
Orbital Debris	Increases in orbital debris would be greater under Alternative 2 than under Alternative 1 because a higher proportion of the tests would occur in the exoatmosphere because of testing associated with space-based interceptors. However, 90 to 95 percent of debris created from exoatmospheric intercepts would reenter Earth's atmosphere within six hours. Because the debris would be on orbit for a relatively short time it would not have a significant impact on orbiting structures. In addition, only a small amount of debris would survive reentry and therefore no significant impacts would be expected.

[3] The environmental impacts associated with GTs and SIFT Scenario 1 are not presented by resource area because such impacts were not found to be substantially different from the impacts described for Alternative 1.

Cumulative Impacts

Placing interceptors in space would add additional structures to space for extended periods of time; therefore, it is appropriate to include in this cumulative impacts analysis other programs that are international in scope which place structures in space for extended periods of time. The International Space Station (ISS) was determined to be such a program. Therefore, the cumulative impacts analysis for Alternative 2 encompasses the discussion of worldwide launch programs as discussed for Alternative 1 and includes a discussion of the impacts of the proposed BMDS on and with the ISS.

Because the majority of BMDS activities would occur in LEO where debris would gradually drop into successively lower orbits and eventually reenter the atmosphere, and the orbital debris produced by BMDS activities would be small in size and in amount, orbital debris from BMDS activities would not pose a long-term hazard to the ISS. The National Aeronautics and Space Administration (NASA) and the U.S. Air Force Space Command monitor orbiting space objects and are aware of instances when the ISS is predicted to be in proximity to space debris that has the potential to damage spacecraft. Prior to every BMDS flight test, MDA assesses the risks posed to spacecraft from post-intercept debris. Launch times are selected to preclude any conjunctions between spacecraft and intercept debris. If necessary, additional analysis is conducted to determine safe launch times within launch windows thereby minimizing the risks to spacecraft. This analysis allows MDA to determine when to safely conduct a flight test. Because the proposed BMDS activities would be expected to produce small quantities of debris which would eventually be removed from orbit and because MDA would only use launch windows when the ISS would not be in the debris, there would be no significant impacts expected to the ISS from the implementation of Alternative 2 for the BMDS.

Summary of Environmental Impacts - No Action Alternative

The No Action Alternative involves the continuation of MDA activities to develop and test discrete weapons, sensors, C2BMC, and support assets and would not include System Integration Testing of these components. For the potential sites being considered for BMDS deployment, the No Action Alternative would be a continuation of activities currently occurring or planned at those locations for individual systems. Therefore, the environmental impacts on the various resource areas associated with the No Action Alternative would be the same as the impacts resulting from continued development and testing of individual missile defense elements.

The decision not to deploy a fully integrated BMDS could result in the inability to respond to a ballistic missile attack on the U.S. or its deployed forces, allies, or friends in a timely and successful manner. Further, this alternative would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress.

ACRONYMS AND ABBREVIATIONS

ABL	Airborne Laser
ABM	Anti-Ballistic Missile
ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
AFB	Air Force Base
AFRL	Air Force Research Laboratory
ait	atmospheric interceptor technology
ALCOR	Advanced Research Project Agency Lincoln C-band Observable Radar
Al_2O_3	Aluminum Oxide (alumina)
ANSI	American National Standards Institute
AMOS	Air Force Maui Optical and Supercomputing Station
ARS	Active Ranging System
ARTCC	Air Route Traffic Control Center
AWS	Arrow Weapon System
BILL	Beacon Illuminator Laser
BM	Battle Management
BMC2	Battle Management/Command and Control
BMC3	Battle Management/Command, Control and Communications
BMDO	Ballistic Missile Defense Organization
BMDS	Ballistic Missile Defense System
BMEWS	Ballistic Missile Early Warning System
BOA	Broad Ocean Area
BTS	Bureau of Transportation Statistics
^{o}C	Degrees Celsius
C2	Command and Control
C2BMC	Command and Control, Battle Management, and Communications
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CEQ	Council on Environmental Quality
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
Cl	Atomic Chlorine
Cl_2	Molecular Chlorine
CM/CM	Critical Measurements and Countermeasures
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COIL	Chemical Oxygen Iodine Laser
COMSATCOM	Commercial Satellite Communications
CONOPS	Concept of Operations

CTF	Combined Test Force
dB	Decibel
dBA	A-weighted decibel
DNL	Day Night Average Noise Level
DoD	Department of Defense
DOT	Department of Transportation
DRMO	Defense Reutilization and Marketing Office
DSP	Defense Support Program
EA	Environmental Assessment
EIS	Environmental Impact Statement
EKV	Exoatmospheric Kill Vehicle
EM	Electromagnetic
EMR	Electromagnetic Radiation
EO	Executive Order
EPA	Environmental Protection Agency
ESA	European Space Agency
ESG	Engagement Sequence Group
ESQD	Explosive Safety Quantity Distance
ETR	Extended Test Range
EWR	Early Warning Radar
^oF	Degrees Fahrenheit
FAA	Federal Aviation Administration
FBX-T	Forward Based X-Band Radar Transportable
FL	Flight Level
FM	Flight Mission
FR	Federal Register
FTS	Flight Termination System
GBI	Ground-Based Interceptor
GBMC2	Ground-Based Midcourse Command and Control
GBR-P	Ground-Based Radar Prototype
GEO	Geosynchronous Earth Orbit
GHz	Gigahertz
GMD	Ground-Based Midcourse Defense
GT	Integrated Ground Test
H_2	Hydrogen
H_2O	Water
HAA	High Altitude Airship
HAIR	High Accuracy Instrumentation Radar
HALO	High Altitude Observatory
HAP	Hazardous Air Pollutant
HEL	High Energy Laser
HCl	Hydrogen Chloride
ICAO	International Civil Aviation Organization

ICBM	Inter-Continental Ballistic Missile
IDC	Initial Defensive Capability
IDLH	Immediately Dangerous to Life and Health
IDO	Initial Defensive Operations
IDOC	Initial Defensive Operations Capability
IDT	In-Flight Interceptor Communication System Data Terminal
IEEE	Institute of Electrical and Electronics Engineers
IFR	Instrument Flight Rules
IPSC	Interagency Perchlorate Steering Committee
IRFNA	Inhibited Red Fuming Nitric Acid
IRST	Infrared Search and Track
ISS	International Space Station
ISTEF	Innovative Science and Technology Experimentation Facility
KEI	Kinetic Energy Interceptor
KLC	Kodiak Launch Complex
LDC	Limited Defensive Capability
L_{eq}	Equivalent Noise Level
LEO	Low Earth Orbit
LHA	Launch Hazard Area
Lidar	Light Detection and Ranging
LOAEL	Lowest Observed Adverse Effect Level
LOS	Level of Service
MDA	Missile Defense Agency
MDIE	Missile Defense Integration Exercises
MEADS	Medium Extended Air Defense System
mg/m^3	Milligrams per cubic meter
mg/kg	Milligrams per kilogram
MHz	Megahertz
MOA	Military Operating Area
MPE	Maximum Permissible Exposure
MSL	Mean Sea Level
MSSS	Maui Space Surveillance System
MSX	Midcourse Space Experiment
N_2	Nitrogen
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NEXRAD	Next Generation Weather Radar
NIOSH	National Institute of Occupational Safety and Health
NFIRE	Near-Field Infrared Experiment
NMD	National Missile Defense
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides

NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries Service	NOAA National Marine Fisheries Service
NOI	Notice of Intent
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
OCONUS	Outside the Continental United States
OSHA	Occupational Safety and Health Administration
PAC-3	PATRIOT Advanced Capability-3
PAVE PAWS	Position and Velocity Extraction Phased Array Warning System
PEIS	Programmatic Environmental Impact Statement
PEL	Permissible Exposure Limit
ppm	parts per million
PM	Particulate Matter
PM_{10}	Particulate Matter with diameter 10 microns or less
$PM_{2.5}$	Particulate Matter with diameter 2.5 microns or less
PMRF	Pacific Missile Range Facility
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
ROD	Record of Decision
RTS	Ronald Reagan Ballistic Missile Defense Test Site
SBIRS	Space-Based Infrared Sensor
SBX	Sea-Based X-Band Radar
SDI	Strategic Defense Initiative
SDIO	Strategic Defense Initiative Organization
SIFT	System Integration Flight Test
SIP	State Implementation Plan
SM	Standard Missile
SO_2	Sulfur Dioxide
SO_X	Sulfur Oxides
SPCC	Spill Prevention, Control and Countermeasure
START	Reduction and Limitation of Strategic Offensive Arms Treaty
STEL	Short Term Exposure Limit
STSS	Space Tracking and Surveillance System
SWPPP	Storm Water Pollution Prevention Plan
THAAD	Terminal High Altitude Area Defense
TILL	Track Illuminator Laser
TLV	Threshold Limit Value
TMD	Theater Missile Defense
TOO	Target of Opportunity

TPS-X	Transportable System Radar
UCAR	University Corporation for Atmospheric Research
U.S.	United States
USAF	United States Air Force
USAKA	U.S. Army Kwajalein Atoll
USFWS	United States Fish and Wildlife Service
U.S.C.	United States Code
USGS	United States Geological Survey
USSR	Union of Soviet Socialist Republics
VFR	Visual Flight Rules
VOC	Volatile Organic Compound
WASP	Widebody Airborne Sensor Platform
WSMR	White Sands Missile Range
XBR	X-Band Radar

1 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1 Introduction

Pursuant to the National Environmental Policy Act (NEPA) of 1969 as amended (42 United States Code [U.S.C.] 4321, et seq.), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] 1500-1508), Department of Defense (DoD) Instruction 4715.9, *Environmental Planning and Analysis*, Presidential Executive Order (EO) 12114, Environmental Effects Abroad of Major Federal Actions, and the applicable DoD military service environmental regulations that implement these laws and regulations, all Federal agencies must consider the environmental consequences when planning for, authorizing, and approving Federal actions. Accordingly, the Missile Defense Agency (MDA) is preparing this Programmatic Environmental Impact Statement (PEIS) to examine the potential for impacts to the environment as a result of the development, test, deployment, and planning for decommissioning activities of an integrated Ballistic Missile Defense System (BMDS).

A PEIS analyzes actions that are broad in scope, occur in phases, and may be widely dispersed geographically. It also creates a comprehensive, global analytical framework that supports subsequent analysis of specific actions at specific locations within the overall system, i.e., tiering. Ranges, installations, and facilities at which specific test activities occur can develop more focused site-specific analyses that tier from this PEIS, thereby reducing analytical requirements and saving resources. This PEIS addresses the BMDS and the development and application of new technologies; evaluates the range of complex programs, architecture, and assets that comprise the BMDS; and provides the framework for future environmental analyses as activities evolve and mature. This PEIS supports the proposed integrated test schedule and considers BMDS deployment and decommissioning activities. This PEIS also considers the cumulative environmental effects that could result from the proposed action.

1.2 Background

In 1955, the United States (U.S.) began to study ways to protect against ballistic missile[1] attack. This study led to the development of the Nike-Zeus System, which accomplished the first successful intercept of a target Inter-Continental Ballistic Missile (ICBM) in 1962. Ten years later, the U.S. and the former Union of Soviet Socialist Republics (USSR) signed the Anti-Ballistic Missile (ABM) Treaty, which limited the development,

[1] A ballistic missile is a projectile traveling without its own power or guidance (like a bullet once it has been shot from a gun; the bullet travels a ballistic trajectory with only the forces of gravity and the atmosphere's friction acting on it).

testing, and deployment of ABM systems and components.[2] A 1974 amendment to the treaty further limited ABM defense deployment to one site at either an ICBM field or near the respective national capital. In 1975, the SAFEGUARD System, the only U.S. BMDS ever deployed, was activated in North Dakota. The SAFEGUARD System only operated until 1976, when it was deactivated.

In 1983, the Strategic Defense Initiative Organization (SDIO) was established within the DoD to manage and direct the research and testing of advanced technologies applicable to the development of a strategic missile defense system. These research and testing activities were known collectively as the Strategic Defense Initiative (SDI). Initially, the main purpose of SDI research concerned protecting the U.S. from weapons of mass destruction involving multiple ICBM strikes.

After the break up of the USSR and the conflict in the Persian Gulf in the early 1990's, the SDIO was refocused to emphasize protecting theater (i.e., outside the U.S.) operations and defending the U.S. against limited missile attacks (i.e., 200 warheads or less). In January 1991, President Bush described the need to acquire and deploy a Ballistic Missile Defense (BMD) system to protect not only the U.S. but also its forces overseas and its friends and allies. Subsequently, Congress provided guidance and direction to the DoD to redirect research and development for protection against ballistic missiles, regardless of their source, by enacting the Missile Defense Act.[3] In May 1993, the DoD reorganized the SDIO, renaming it the Ballistic Missile Defense Organization (BMDO).

In October 1993, the DoD completed the *Report on the Bottom-Up Review*, which reviewed the need for restructuring programs within the DoD. With respect to BMD, the review recommended the acquisition of a robust Theater Missile Defense (TMD) system[4], combined with the further development, but not the acquisition, of a more limited National Missile Defense (NMD) system. Accordingly, the DoD analyzed the proposed TMD system, its alternatives, and their potential environmental impacts in the 1993 *Final Theater Missile Defense Programmatic Life-Cycle Environmental Impact*

[2] MDA activities are in compliance with the Reduction and Limitation of Strategic Offensive Arms Treaty (START). Any mention of target ICBMs in this PEIS refers to decommissioned ICBMs.

[3] The Missile Defense Act enacted as part of the National Defense Authorization Act of 1992 (Public Law 92-190) established goals for theater and national missile defenses. It directed the DoD to develop a TMD system for possible deployment at an initial ABM Treaty-compliant site by 1996 or as soon as appropriate technology would allow. In July 1992, Secretary of Defense Cheney outlined a plan for the development and deployment of theater and national missile defenses. In passing the National Defense Authorization Act (Public Law 92-484) of 1993, Congress deleted the dates contained in the Act and in the conference report accompanying this Act; Congress endorsed a plan to deploy a limited NMD system by 2002.

[4] A theater missile is defined as "any missile (e.g., ballistic, cruise, or air-to-surface guided missile) directed against a target in an area of operations outside the U.S." (*Final Theater Missile Defense Programmatic Life cycle Environmental Impact Statement* 1993) The purpose of TMD is to "prevent or counter the launch of theater missiles against U.S. forces and allies, protect U.S. forces and allies from missiles launched against them, reduce the probability of and minimize the effects of damage caused by such an attack, and manage a coordinated response to a theater missile attack and integrate it with other combat operations."

Statement (TMD PEIS) and in the 1994 *Theater Missile Defense Extended Test Range Environmental Impact Statement* (TMD ETR EIS). The TMD PEIS included analysis of the environmental impacts of the research, development, and testing of TMD systems as well as the later life cycle phases of the system, such as production, basing, and decommissioning. The TMD ETR EIS included analysis of the environmental impacts of conducting extended-range TMD missile demonstration and operational test flights, target intercept tests, and sensor tests.

By 1994, the BMDO believed that the definition of an NMD system, as well as the technologies and resources required to implement the system, were sufficiently well understood to allow for a programmatic analysis of environmental impacts. Therefore, the BMDO issued a BMD PEIS that evaluated the environmental impacts of alternatives that would provide the U.S. the capability to produce and deploy an NMD system in the future. It further examined the cumulative environmental impacts of both the NMD and TMD systems.[5] Although the 1994 BMD PEIS ultimately selected the technology readiness (no action) alternative (i.e., the continuation of ongoing NMD activities and programs initiated under existing Congressional direction that were part of BMDO's technology readiness program) the BMD PEIS also analyzed several systems acquisition alternatives.[6] These alternatives, which involved more intensive research, development, and system-level testing as part of a program to acquire a specific defense system, included various combinations of ground-based and/or space-based elements (e.g., sensors, interceptors, and systems management tools).

Unlike the preferred technology readiness alternative, the system acquisition alternatives evaluated in the BMD PEIS had defined system architectures and descriptions of system acquisition life cycle phases. Thus, for those alternatives, the BMD PEIS evaluated potential environmental impacts of NMD activities beyond development and testing including: system production, fielding (deployment), operations and maintenance, and eventual decommissioning of facilities. The BMD PEIS programmatic analysis of the system acquisition alternatives would support “decisions on research, development, and testing activities” and thus would also serve “as the foundation from which future environmental documentation can be prepared, if needed.”

On February 16, 1996, the DoD completed another review of its BMD program. At that time, the DoD began an NMD Deployment Readiness program that would involve a shift

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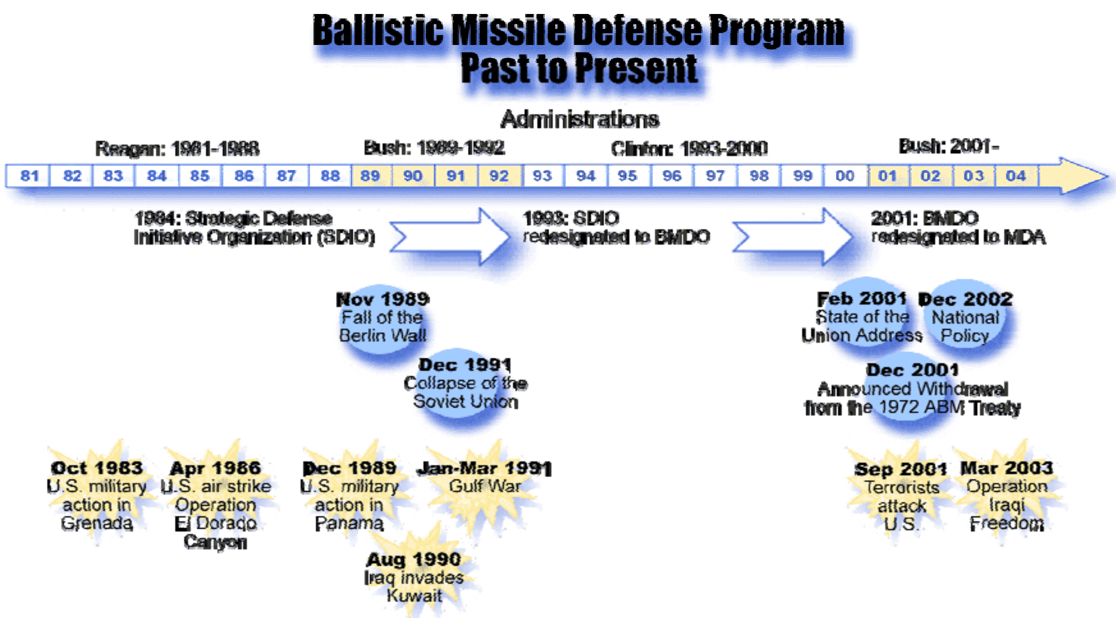
[5] The BMD PEIS focused more intensively on NMD because the DoD determined that the TMD program had independent utility and had already completed the TMD PEIS in 1993. The DoD incorporated the TMD PEIS by reference into the BMD PEIS, however, because the DoD intended TMD and NMD to operate as a multi-layered ballistic missile defense that would commit an appropriate interceptor, whether TMD or NMD, to defend against an attack. The BMD PEIS evaluated the combined effects of the TMD and NMD programs in a cumulative impacts analysis.

[6] Record of Decision (ROD) for the Final Programmatic Environmental Impact Statement (PEIS) for the BMD Program signed April 25, 1995.

from a technology readiness to a deployment readiness program, but without a decision to deploy an NMD system at that time. Therefore, DoD adopted a "3 plus 3" program for NMD, which would have enabled the U.S. to develop, within three years, elements of an initial NMD system that could be deployed within three years of a deployment decision. The DoD expected an NMD three-year development phase, which commenced in 1997, to culminate in a deployment readiness review in the year 2000, at which time the DoD would have decided whether to begin a three-year program to deploy an NMD system. An overview of the major events in the BMDS timeline is depicted in Exhibit 1-1.

Exhibit 1-1. Ballistic Missile Defense Timeline



On July 15, 1998, the "Commission to Assess the Ballistic Missile Threat to the United States"[7] issued a report to Congress. The report unanimously concluded that there had been concerted efforts by a number of overtly or potentially hostile nations (including North Korea, Iran, and Iraq) to acquire ballistic missiles with biological or nuclear payloads, posing a growing threat to the U.S. The report concluded that these nations would be able to inflict major destruction on the U.S. within approximately five years of a decision to acquire such a capability (10 years in the case of Iraq). The report also concluded that the threat to the U.S. posed by these emerging capabilities was broader, more mature, and evolving more rapidly than had been reported in estimates and reports by the Intelligence Community and that ultimately, the U.S. might have little or no

[7] The Commission's mandate was to "assess the nature and magnitude of the existing and emerging powers to arm ballistic missile with weapons of mass destruction." Members of the Commission were nominated by Congressional leaders and appointed by the Director of the Central Intelligence Agency.

warning before operational deployment.[8] For these reasons, the Commission unanimously recommended that "the analyses, practices, and policies" of the U.S. "that depend on expectations of extended warning of deployment be reviewed and, as appropriate, revised to reflect the reality of an environment in which there may be little or no warning."

On November 17, 1998, the BMDO published in the *Federal Register* (FR) a Notice of Intent (NOI) "to prepare an EIS for a potential NMD deployment, should the U.S. Government make such a decision."[9] The BMDO, in July 2000, issued the final Environmental Impact Statement (EIS) for NMD deployment. The proposed action identified in the final EIS was a decision to deploy and operate an NMD system consisting of five elements, including: 1) ground-based interceptors (GBIs)[10]; 2) Battle Management/Command and Control (BMC2)[11]; 3) an X-band radar (XBR)[12]; 4) an upgraded early warning radar (EWR)[13]; and 5) space-based satellite detection systems.[14] The final NMD Deployment EIS further specified that as part of a program to deploy an NMD system, a "Test, Training, and Exercise Capability" would be implemented.

In October 1999, while the draft NMD Deployment EIS was being circulated for public comment, the BMDO successfully completed its first test involving a planned intercept of

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[8] The Commission's report also unanimously determined that the Intelligence Community's ability to provide timely and accurate estimates of ballistic missile threats was eroding and that the warning times the U.S could expect for new, threatening ballistic missile deployments were decreasing.

[9] 63 FR 63915 (1998). In the notice, the BMDO identified the technological elements of the NMD system that would be analyzed in the EIS and stated

> "The decision to be made is whether to deploy such a system. This decision will be based on an analysis of the potential limited strategic ballistic missile threat to the U.S. from a rogue nation, technical readiness of the NMD system for deployment, and other factors including potential environmental impacts. If the decision is to deploy, then sites would be selected from the range of locations studied in the EIS. The EIS will provide the U.S. Government with the information necessary to properly account for the environmental impacts of this decision."

As the BMDO further explained

> "[s]hould the deployment options not be exercised in the year 2000, improvements in NMD system element technology would continue, while an ability to deploy a system within three years of a decision would be maintained."

[10] The GBI's mission is to intercept incoming ballistic missile warheads outside the Earth's atmosphere (exoatmospheric) and destroy them by the force of the impact alone, i.e., without explosives or nuclear warheads. The GBI element includes the interceptor (i.e., missile), kill vehicle, and associated launch and support equipment, silos, facilities, and personnel.

[11] BMC2 is a sub-component of Command, Control, Battle Management and Communications (C2BMC) that supplies the means to plan, select, and adjust missions and courses of action.

[12] The XBRs would be ground-based, multi-function radars that, for NMD purposes, would perform tracking, discrimination, and kill assessments of incoming ballistic missile warheads.

[13] Early warning phased-array surveillance radars, for example, "Position and Velocity Extraction Phased Array Warning System (PAVE PAWS)," are used to detect, track, and provide early warning of sea-launched ballistic missiles. These radars also are used to track satellites and space debris.

[14] Existing DoD satellites provide the U.S. early warning satellite capability. These satellites are comparatively simple, inertially fixed, geosynchronous earth orbit (GEO) satellites with an unalterable scan pattern.

an ICBM.[15] The test demonstrated "hit-to-kill technology" to intercept and destroy the ballistic missile target. The next two tests, which were conducted in January 2000 and July 2000, respectively, did not result in an intercept.

On September 1, 2000, President Clinton announced that, due to technical uncertainties, unsuccessful flight tests, and concerns about potential implications for the ABM Treaty, he would not authorize deployment of an NMD system but would leave that decision to his successor.[16] In the interim, President Clinton stated the DoD would continue developing and testing radars and interceptors that would defend the U.S. against incoming ballistic missiles.

In early 2001 with the election of George W. Bush as President, the BMDO began to expand the test infrastructure to support greater realism in the test program and restructured the development approach into one that adopted spiral development of technologies and capabilities in coherent, incremental blocks.[17] Elements of the BMDO began development of a "test bed" in the Pacific to support this effort.[18]

Because the ABM Treaty limited the development, testing, and development of ballistic missile defense capabilities, President Bush gave Russia formal notice on December 13, 2001 that the U.S. would withdraw from the ABM Treaty in six months. On January 2, 2002, Secretary of Defense Rumsfeld issued a directive to the DoD to establish a single development program for all the work needed to design, develop, and test elements of an integrated BMDS that would operate under a newly titled MDA.[19]

To support test bed activities, MDA completed the *Ground-Based Midcourse Defense Validation of Operational Concept Environmental Assessment* (GMD Validation of

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[15] Exoatmospheric Reentry Vehicle Interceptor System Environmental Assessment (EA), 1987, analyzed the launch of a Minuteman target from Vandenberg Air Force Base (AFB) and the launch of a GBI from the Ronald Reagan Ballistic Missile Defense Test Site (RTS), Kwajalein Atoll.
[16] On May 20, 1999 Congress passed the National Missile Defense Act to "deploy as soon as is technologically possible an effective NMD system..."
[17] "Spiral development" is an iterative process for developing the BMDS by refining program objectives as technology becomes available through research and testing with continuous feedback between MDA, the test community, and military operators. Thus, MDA can consider deployment of a missile defense system that has no specified final architecture and no set of operational requirements, but which will be improved incrementally over time. Blocks are synchronized sets of capability developments that can be added to the BMDS, build on previous blocks, and will be verified prior to transfer to the military services.
[18] "Test bed" is defined as a collection of integrated BMD element development hardware, software, prototypes, and surrogates, as well as supporting test infrastructure (e.g., instrumentation, safety/telemetry systems, and launch facilities) configured to support realistic development and testing of the BMDS.
[19] The MDA's mission is to develop, test and prepare for deployment a missile defense system. Using complementary interceptors; land-, sea-, air-, and space-based sensors; and battle management, command and control, and communications systems, the planned missile defense system will be able to engage and negate all classes and ranges of ballistic missile threats. The Secretary directed that MDA "employ a BMDS that layers defenses to intercept missiles in all phases of their flight (i.e., boost, midcourse, and terminal) against all ranges of threats."

Operational Concept EA) to construct test bed assets at Fort Greely, Alaska and at other supporting Alaska locations.[20] The GMD Validation of Operational Concept EA primarily examined ground activities regarding the construction of six GBI silos and support facilities to validate the operational concept of the test bed. The GMD Validation of Operational Concept Supplemental EA further analyzed additional infrastructure requirements necessary to support validation of the test bed operational concept.[21]

In July 2003, MDA completed the *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement* (GMD ETR EIS), which provided for the construction and operation of additional launch and communication facilities in the Pacific test bed, and for development and operation of a sea-based X-band radar (SBX).[22]

Following continued test bed development and successful flight test activities, President Bush decided to provide the nation with an operational missile defense capability. On December 17, 2002, the President announced his decision to field an initial defensive operation (IDO) capability.[23] The initial fielding would provide a modest protection of the U.S. and would be improved over time. In view of this decision, MDA issued a Record of Decision (ROD) from the 2000 NMD Deployment EIS to support the fielding of up to 40 GBI silos at Fort Greely, Alaska.[24] In addition, the IDO capability would include four silos at Vandenberg Air Force Base (AFB). This latter action was addressed in the *Environmental Assessment for GMD Initial Defensive Operations Capability (IDOC) at Vandenberg Air Force Base (AFB).*[25]

Prior to initiation of this PEIS, MDA and its predecessor agencies prepared several programmatic NEPA documents regarding ballistic missile defense.[26] In addition, each program element prepared extensive NEPA documentation to cover its own specific, tiered documents. Ballistic missile defense has again evolved to the point that this programmatic EIS is being prepared to consider the coordinated BMDS as envisioned by the January 2002 creation of the MDA.

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[20] The GMD Validation of Operational Concept EA Finding of No Significant Impact was signed in April 2002.

[21] The GMD Validation of Operational Concep*t* Supplemental EA Finding of No Significant Impact was signed in January 2003.

[22] The GMD ETR EIS addressed dual GBI and target capabilities at Vandenberg AFB, the RTS, Kwajalein Atoll, and the Kodiak Launch Complex (KLC) in Kodiak, Alaska. It further addressed necessary infrastructure in the Pacific to support these capabilities. There have been two RODs for actions analyzed in this EIS: 1) *ROD to Establish a GMD ETR*, dated August 2003, and 2) *Supplemental ROD to Conduct Target Launches from Kodiak Launch Complex in Support of GMD ETR*, dated November 2003.

[23] In October 2004, MDA achieved a limited missile defensive capability (LDC) when certain BMDS test components could also be placed on alert and used in defensive operations. As decisions are made based on technical performance, maturity, military utility, and national security, assets may be "placed on alert" as operational defensive capabilities. These defensive capabilities may initially be limited but could become more robust as more capability is developed or acquired.

[24] The *ROD To Establish a GMD Initial Defensive Operations Capability (IDOC) at Fort Greely, Alaska*, was finalized April 2003.

[25] The GMD IDO Capability at Vandenberg AFB Finding of No Significant Impact was signed in October 2003.

[26] The most recent programmatic documents were the 1993 TMD PEIS and the 1994 BMD PEIS.

1.3 Purpose of the Proposed Action

The purpose of the proposed action is to incrementally develop and deploy a BMDS, the performance of which can be improved over time, that layers defenses to intercept ballistic missiles of all ranges in all phases of flight.

1.4 Need for the Proposed Action

The proposed action is needed to protect the U.S., its deployed forces, friends and allies from ballistic missile threats.

In 1972, only eight countries had ballistic missiles; today there are over 30 and the threat is pervasive and proliferating. The U.S. national policy for addressing the threat of ballistic missiles and weapons of mass destruction includes a dual-path approach of both diplomatic and military measures. Diplomatically, the U.S. tries to assure our allies that we will be a dependable and strong partner for our collective security and also to dissuade or prevent potential adversaries from acquiring or developing ballistic missiles and related technologies altogether. The second path would require a non-offensive, BMDS that would protect the U.S. and its friends and allies from short-, medium-, and long-range threats.

1.5 The Proposed Action

The MDA proposes to develop, test, deploy and to plan for related decommissioning activities for an integrated BMDS using existing infrastructure and capabilities, when feasible, as well as emerging and new technologies, to meet current and evolving threats from ballistic missiles. The Secretary of Defense assigned the MDA the mission to develop and field an integrated BMDS capable of providing a layered defense for the homeland, deployed forces, friends, and allies against ballistic missiles of all ranges in all phases of flight.

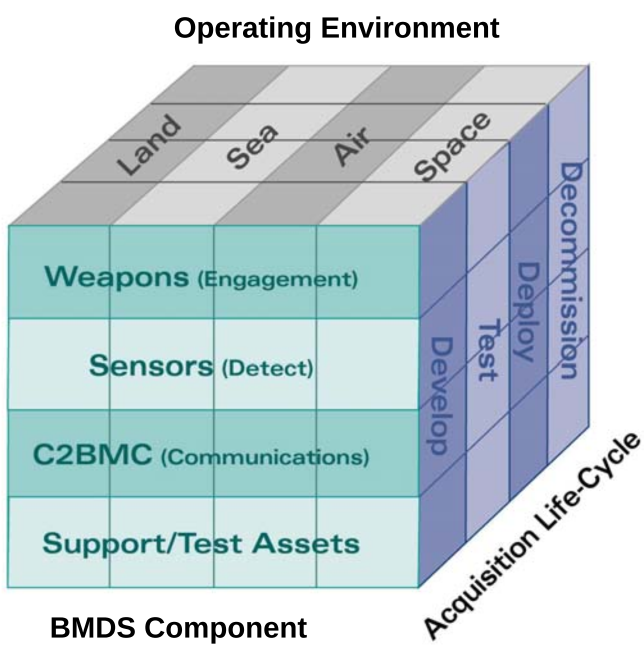
1.6 Scope of the Programmatic Environmental Impact Statement

This PEIS identifies, evaluates and documents, at the programmatic level, the potential environmental effects of the development, testing, and deployment of a BMDS, along with planning for its eventual decommissioning. Although there is already extensive environmental analysis for many of the existing and projected components of the proposed BMDS, this PEIS examines potential environmental impacts of MDA's concept for developing an integrated BMDS, based on current Congressional and Presidential direction. The BMDS PEIS will provide the framework for analyzing the development, testing and deployment of the range of complex components, architectures, and assets comprising the proposed BMDS, as well as planning for their decommissioning. The BMDS PEIS considers cumulative environmental effects that could result from the

proposed action at an appropriate programmatic level. This framework also will provide a basis from which to tier environmental impact analyses for future MDA activities.

This PEIS will address the life cycle of the proposed BMDS and its components from original research and development through planning for decommissioning. Conceptually, the BMDS is envisioned to be a layered system of weapons (i.e., interceptors and lasers), sensors (i.e., radars, infrared, optical and lasers), Command and Control, Battle Management, and Communications (C2BMC), and support assets (i.e., equipment, infrastructure and test assets), each with specific functional capabilities, working together to defend against all classes and ranges of threat ballistic missiles in the boost, midcourse, and terminal flight phases. Exhibit 1-2 depicts the multi-dimensional complexities

Exhibit 1-2. Complexities of the BMDS



involved in considering the impacts of implementing an integrated BMDS in terms of its components, acquisition life cycle activities, and operating environments.

There currently are no final or fixed architecture and no set operational requirements for the proposed BMDS. Instead, development, demonstration, and deployment of the integrated BMDS would occur over several years in an evolutionary, spiral development process designed to field an initial capability in 2004-2005 and gradually replace, enhance, or supplement this with layers of increasingly capable weapons and sensors, made possible by emerging technologies. Each new technology would go through development; promising technologies would go through testing and demonstration; and proven technologies would be incorporated into the BMDS.

Development includes the various activities that would support research and development of the BMDS components and the overall system. Development activities would include planning, budgeting, research and development, systems engineering, site preparation and construction, maintenance and sustainment, manufacture of test articles (prototypes) and initial testing, and tabletop exercises. Tabletop exercises would be used to develop and improve the Operations Concepts, the broad outline or overall picture of BMDS operations. This PEIS addresses technologies that currently are in the development stage and provides a framework for evaluating new technologies that may be developed in the future.

Testing of the BMDS involves demonstration of BMDS components through test and evaluation. The successful demonstration of the BMDS would rely on a complex testing program aimed at producing credible test data for system characterization, verification, and assessment. To confirm these capabilities, MDA would continue to develop a Test Bed using existing and new land-, sea-, air- and space-based assets. Some construction at various geographic locations would be required to support infrastructure and assets where BMDS components and the overall system would be tested. The BMDS PEIS includes ongoing and planned tests (e.g., ground tests [GTs] and flight tests) of components that might be incorporated into the BMDS, as well as tests of the layered, integrated BMDS through increasingly complex System Integration Tests including system integration flight tests (SIFTs) through 2010 and beyond.

Deployment of the BMDS refers to the fielding (including the manufacture, site preparation, construction and transport of systems) and sustainment (operations and maintenance, training, upgrades, and service life extension) of BMDS architecture. The evolving BMDS is intended to have the capability over time to deploy different combinations of interoperable sensor suites, weapons, and C2BMC. After production, some BMDS components would be transported to deployment locations. Deployment also would involve the transfer of facilities, elements, and programs to the military services. The BMDS PEIS includes start up and ongoing operations and maintenance activities that would be required at the facility locations. For some technologies and fixed assets, such as large radars, proposed deployment locations can be identified. For other technologies, such as mobile launchers and the Airborne Laser (ABL), potential deployment locations can be anticipated only in a general sense, as actual deployment decisions would depend on future geopolitical conditions and security concerns. Although the operational life of some BMDS technologies can be estimated, it is difficult to estimate for many proposed technologies given both the uncertainty of their development and deployment schedules as well as the potential for technology upgrades and service life extensions.

Decommissioning would involve the demilitarization and final removal and disposal of the BMDS components and assets. Plans would be made for decommissioning BMDS components by either demolition or transfer to other uses or owners.

Typical activities involved in developing, testing, deploying and planning for decommissioning the proposed BMDS are identified in Exhibit 1-3.

Exhibit 1-3. Typical Activities for BMDS Proposed Action

Life Cycle Phase	Components	Typical Activities
Development	**Weapons - Laser** **Weapons - Interceptor** **Sensors** **C2BMC** **Support Assets - Equipment** **Support Assets - Infrastructure** **Support Assets - Test Assets**	Planning/Budgeting
		Research and Development
		Systems Engineering
		Site Preparation and Construction
		Maintenance or Sustainment
		Manufacturing of Prototypes
		Testing of Component Prototypes
		Tabletop Exercises
Testing*	**Weapons - Laser**	Manufacturing
		Site Preparation and Construction
		Transportation
		Activation
	Weapons - Interceptor	Manufacturing
		Site Preparation and Construction
		Transportation
		Prelaunch
		Launch/Flight
		Postlaunch
	Sensors	Manufacturing
		Site Preparation and Construction
		Transportation
		Activation
	C2BMC	Manufacturing
		Site Preparation and Construction
		Transportation
		Activation
	Support Assets - Equipment	Manufacturing
		Operational Changes
		Site Preparation and Construction
		Transportation
	Support Assets - Infrastructure	Site Preparation and Construction
	Support Assets - Test Assets	Manufacturing
		Site Preparation and Construction
		Transportation

Exhibit 1-3. Typical Activities for BMDS Proposed Action

<table>
<tr><th>Life Cycle Phase</th><th>Components</th><th>Typical Activities</th></tr>
<tr><td rowspan="5"></td><td rowspan="5"></td><td>Activation</td></tr>
<tr><td>Prelaunch</td></tr>
<tr><td>Launch/Flight</td></tr>
<tr><td>Use of Countermeasures, Simulants, or Drones</td></tr>
<tr><td>Postlaunch</td></tr>
<tr><td rowspan="12">Deployment</td><td rowspan="12">Weapons - Laser
Weapons - Interceptor
Sensors
C2BMC
Support Assets - Equipment
Support Assets - Infrastructure
Support Assets - Test Assets</td><td>Manufacturing</td></tr>
<tr><td>Site Preparation and Construction</td></tr>
<tr><td>Transportation</td></tr>
<tr><td>Prelaunch</td></tr>
<tr><td>Launch/Flight</td></tr>
<tr><td>Postlaunch</td></tr>
<tr><td>Activation</td></tr>
<tr><td>Maintenance or Sustainment</td></tr>
<tr><td>Upgrades</td></tr>
<tr><td>Training</td></tr>
<tr><td>Use of Human Services</td></tr>
<tr><td>Service Life Extension</td></tr>
<tr><td rowspan="2">Decommissioning</td><td rowspan="2">Weapons - Laser
Weapons - Interceptor
Sensors
C2BMC
Support Assets - Equipment
Support Assets - Infrastructure
Support Assets - Test Assets</td><td>Demilitarization</td></tr>
<tr><td>Disposal</td></tr>
</table>

*Includes System Integration Testing that includes integrated GTs as well as system integration flight tests (SIFTs) with a single weapon with single intercept scenario and a multiple weapons with multiple intercepts scenario.

1.7 Consultations and Coordination

As the lead agency, MDA has primary responsibility for preparing the PEIS. As part of the scoping process, the lead agency is required to consult with affected Federal, state, local, and tribal agencies, and other interested parties. A continuing relationship with affected and interested entities can be established to promote cooperation and resolution of mutual land-use and environment-related problems, and to promote the concept of

regional ecosystem management as well as general cooperative problem solving. The agencies involved in this process are referred to as coordinating or consulting agencies.

Consulting agencies do not enter into a legal agreement with the lead agency. Consulting agencies may submit comments and provide data to support the environmental analysis, but they do not participate in the internal review of documents, issues, and analyses. A consulting agency does not participate directly in the development of technical analyses and conclusions.

The MDA has identified several agencies that may be coordinating or consulting agencies for this PEIS. These agencies include: National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries Service), the Advisory Council on Historic Preservation (ACHP), U.S. Fish and Wildlife Service, and the U.S. Federal Aviation Administration (FAA).

A cooperating agency is any Federal agency, other than a lead agency, that has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment. (40 CFR Part 1508.5) The MDA has held informal meetings with several agencies; however, MDA has not requested that any agencies participate as cooperating agencies for this PEIS. See Appendix A for additional information on consultation and coordination.

1.8 Summary of the Public Involvement Process

The MDA provided several opportunities and means for public involvement during scoping and throughout the preparation of the BMDS PEIS. The CEQ implementing regulations for NEPA describe the public involvement requirements for agencies (40 CFR 1506.6). Public participation in the NEPA process not only provides for and encourages open communication between the MDA and the public, but also promotes better decision-making. Throughout the preparation and review of the Draft BMDS PEIS, the MDA aimed to obtain meaningful input concerning the issues that should be addressed.

1.8.1 Scoping

Scoping for the development of the BMDS PEIS began with the publication of the NOI in the FR (68 FR 17784) on April 11, 2003. See Appendix B for a detailed description of scoping and a copy of the NOI. During scoping, the MDA invited the participation of Federal, state, and local agencies, Native American Tribes, environmental groups, organizations, citizens, and other interested parties to assist in determining the scope and significant issues to be evaluated in the BMDS PEIS. The MDA developed a web site, http://www.mda.mil/mdalink/html/mdalink.html, to provide information on the BMDS PEIS and to solicit scoping comments. The MDA also established toll-free phone and

fax lines, an e-mail address, and a U.S. postal service mailbox for submittal of public comments and questions.

MDA held public scoping meetings in accordance with CEQ regulations. (40 CFR 1501.7) Meetings took place in Arlington, Virginia on April 30, 2003; Sacramento, California on May 6, 2003; Anchorage, Alaska on May 8, 2003; and Honolulu, Hawaii on May 13, 2003. The purpose of the scoping meetings was to request input from the public on concerns regarding the proposed activities as well as to gather information and knowledge of issues relevant to analyzing the environmental impacts of the BMDS. The public scoping meetings also provided the public with an opportunity to learn more about the MDA's proposed action and alternatives. In addition to announcing the public scoping meetings in the NOI, the MDA placed legal notices in local and regional newspapers and notified state governors, mayors, members of Congress and local media representatives about the scoping meetings. See Appendix B for additional information on public involvement.

During scoping, the MDA received 285 comments. The MDA requested scoping comments be submitted by June 12, 2003, to be considered in developing the Draft BMDS PEIS. The majority of comments were related to opposition to the BMDS, especially with regard to the use of space as a weapons platform; concern that the program would bankrupt the economy and that Federal funds should be channeled to address socioeconomic problems, better health care and insurance coverage, and education; and concern that the BMDS would create an arms race, especially in space. Other key issues included opposition to development of nuclear weapons and concern that missile defense could be a first strike capability for U.S. worldwide military domination. Public comments concerning DoD policy, budget, and program issues are outside the scope of the Draft BMDS PEIS. Comments received pertaining to reasonable alternatives to the proposed action, resource areas, human health, and environmental impacts were considered in this BMDS PEIS. See Appendix B for comment excerpts related to resource areas and human health and environmental impacts.

1.8.2 Public Comment Period

The public comment period began with the publication of the Notice of Availability (NOA), published in the FR by the Environmental Protection Agency (EPA) on September 17, 2004. The NOA announced the availability of the Draft PEIS, initiated the public comment period for the NEPA process, and requested comments on the Draft PEIS. The MDA also published a NOA in the FR on September 17, 2004, which provided information on the proposed action and alternatives, listed the dates and locations of the public hearings, and provided contact information for submitting comments to the MDA. See Appendix B for a detailed description of the public comment period and a copy of the NOA.

A downloadable version of the Draft PEIS was available on the BMDS PEIS web site and hardcopies of the document were placed in the following public libraries:

- Anchorage Municipal Library, 3600 Denali Street, Anchorage, AK 99503
- Mountain View Branch Library, 150 South Bragaw Street, Anchorage, AK 99508
- California State Library, Library and Courts Building, 914 Capital Mall, Sacramento, CA 95814
- Sacramento Public Library, 828 I Street, Sacramento, CA 95814
- Hawaii State Library, Hawaii Documents Center, 478 South King Street, Honolulu, HI 96813
- University of Hawaii at Manoa, Hamilton Library, 2550 The Mall, Honolulu, HI 96822
- Arlington County Public Library, Central Branch, 1015 North Quincy Street, Arlington, VA 22201
- District of Columbia Public Library, Central Branch – Martin Luther King, Jr. Memorial Library, 901 G Street, NW, Washington, DC 20001

MDA held public hearings in Arlington, Virginia on October 14, 2004; Sacramento, California on October 19, 2004; Anchorage, Alaska on October 21, 2004; and Honolulu, Hawaii on October 26, 2004. In addition to announcing the public hearings in the NOA, the MDA placed legal notices in local and regional newspapers and notified state governors, mayors, and members of Congress. See Appendix B for additional information on the public hearing notification process.

The purpose of the public hearings was to solicit comments on the environmental areas analyzed and considered in the Draft PEIS. Appendix B contains a reproduction of the transcripts of the public hearings.

During the public review period, the MDA received approximately 8,500 comments on the Draft PEIS. See Appendix K for an overview of comments received on the Draft PEIS and the MDA's responses to in-scope comments. Additional areas of analysis—orbital debris, perchlorate, and radar impacts to wildlife—are addressed in more technical detail in Appendices L, M, and N, respectively.

1.9 Related Documentation

Existing relevant NEPA analysis and health and safety documentation is incorporated by reference. These documents are listed in Appendix C, Related Documentation. The relevant information and analyses contained in these documents is summarized in this PEIS where appropriate.

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2 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

The proposed action is to develop, test, deploy, and to plan for decommissioning activities for an integrated BMDS using existing infrastructure and capabilities, when feasible, as well as emerging and new technologies, to meet current and evolving threats in support of the MDA's mission.

2.1 BMDS Concept

The BMDS is designed to negate threat ballistic missiles of all ranges in all phases of flight. To achieve this mission, the BMDS would be made up of **components** (i.e., weapons; sensors; C2BMC; and support assets). These components would be

> ***Component***: Subsystem, assembly, or subassembly of logically grouped hardware and software, that performs interacting tasks to provide BMDS capability at a functional level.

assembled into programs known as **elements**, which can operate independently or together to defeat a threat missile.

> ***Element:*** A functional set of integrated components comprising a stand-alone defensive capability**.** The elements provide "blueprints" for some of the specific functional capabilities that would be included in the proposed BMDS. However, the configuration of these elements is dependent upon the ongoing testing and enhancement of their components.

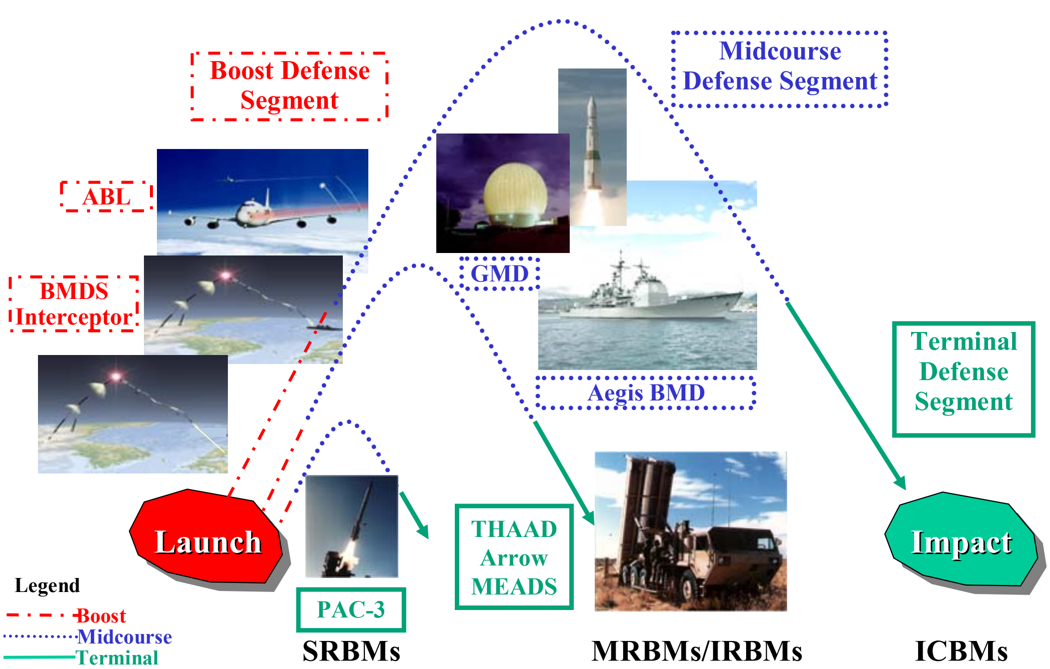
Multiple defensive weapons are required to create a layered defense comprised of multiple intercept or shot opportunities along the incoming threat missile's trajectory. These weapons would be used from a variety of platforms (i.e., any military structure or vehicle bearing weapons). This layered defense would provide a defensive system of capabilities that could back up one another. For example, one element could engage a threat missile in its boost phase and other elements could be used to intercept the threat missile in later phases if initial intercept attempts were unsuccessful. As shown in Exhibit 2-1, ballistic missiles can be categorized based on their approximate flight distances.

Exhibit 2-1. Types and Maximum Ranges of Ballistic Missiles

Type of Ballistic Missile	Approximate Flight Distance in kilometers (miles)
Short Range Ballistic Missile	600 (373)
Medium Range Ballistic Missile	1,300 (808)
Intermediate Range Ballistic Missile	5,500 (3,418)
Inter-Continental Ballistic Missile (ICBM)	10,000 (6,214)

Each type of ballistic missile has three distinct phases of flight: boost, midcourse, and terminal. A flight phase is a portion of the path followed by an object moving through the atmosphere or space. Each phase of flight presents its own challenges to a defensive intercept due to variations in speed, configuration, altitude, and range. The proposed BMDS is envisioned to be capable of defending against all classes of threat ballistic missiles in all phases of flight. Exhibit 2-2 presents missile flight phases also defined as defense segments with the existing BMDS elements designed to operate in them. Please refer to the legend on Exhibit 2-2 to identify the elements that are in the various flight phases or defense segments.

Exhibit 2-2. Ballistic Missile Flight Phases and Defense Segments



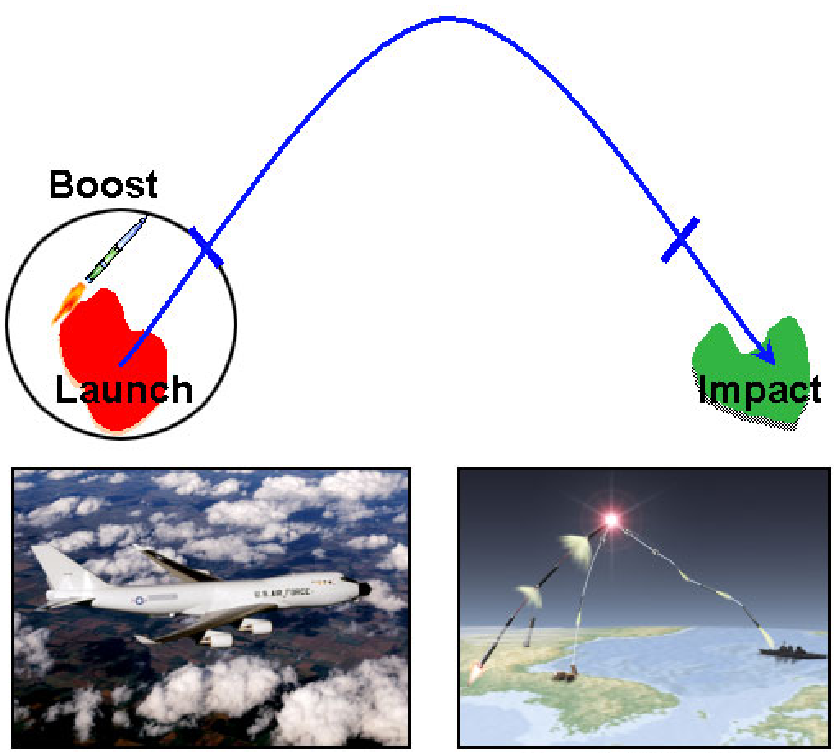
The following section describes each of the three phases of ballistic missile flight, and the currently configured or planned program elements within the BMDS that are designed to address the threat missile within that phase. An overview of the program elements is provided in Appendix D.

2.1.1 BMDS Layered Defense and Missile Flight Phases

2.1.1.1 Boost Phase and the Boost Defense Segment

The ***Boost Phase*** (see Exhibit 2-3) is the first phase of a ballistic missile trajectory, when the rocket engine is ignited and the missile is lifting off and setting out on a specific path. The missile is powered by its engines throughout this phase.

Exhibit 2-3. Boost Phase and the Boost Defense Segment



Airborne Laser

Terrestrial Test Bed
Kinetic Energy Interceptor

- Ballistic missiles are most vulnerable during boost – relatively easy to find and moving slowly
- BMDS needs to be alerted and positioned near the enemy launch site to engage in boost phase
- Requires quick reaction times, high confidence decision making, and multiple engagement capabilities
- Missile is within Earth's atmosphere (endoatmosphere)
- Boost phase lasts about 180 to 600 seconds
- Key elements: ABL and Kinetic Energy Interceptor (KEI)

Currently configured or planned BMDS elements in the boost defense segment include

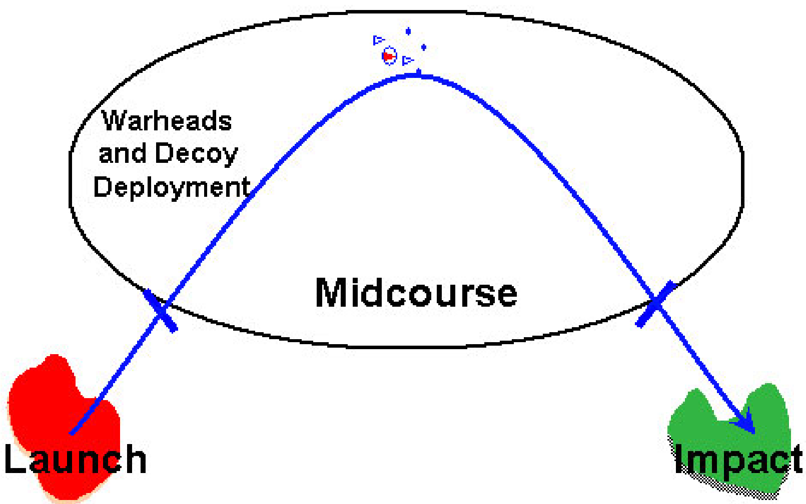
Airborne Laser (ABL). The ABL involves putting a weapons class laser aboard a modified Boeing 747 aircraft and using that laser to destroy enemy ballistic missiles in the boost phase.

Kinetic Energy Interceptor (KEI or BMDS Interceptor). The primary objective of the KEI or BMDS Interceptor program is to develop an interceptor capable of destroying ICBMs in the boost phase.

2.1.1.2 Midcourse Phase and the Midcourse Defense Segment

The *Midcourse Phase* (see Exhibit 2-4) begins when the rocket engine cuts off and the threat missile travels a ballistic trajectory. During this phase, the threat missile is approximately 100 kilometers (62 miles) above Earth's surface. At this point it could deploy decoys to confuse detection and discrimination systems and/or a warhead that continues on the missile's trajectory towards its target.

Exhibit 2-4. Midcourse Phase and the Midcourse Defense Segment



Ground-Based
Interceptor Launch

Aegis BMD

- Ballistic missiles "coast" for several minutes during midcourse and may deploy warheads and decoys
- BMDS uses multiple sensors to determine "real" threat and directs weapons to destroy threat objects in space
- Threat missile is about 100 kilometers above the Earth's surface (exoatmosphere)
- Midcourse phase lasts about 1200 seconds
- Key elements: Ground-Based Midcourse (GMD) and Aegis BMD

BMDS elements currently configured to comprise the midcourse defense segment include

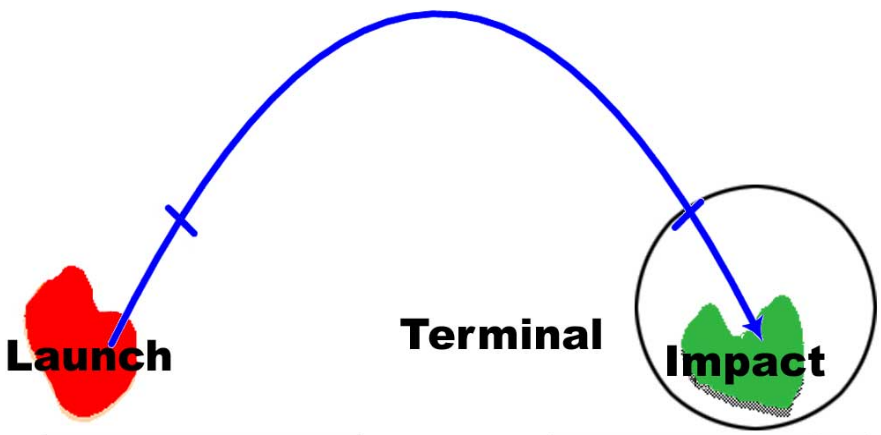
Ground-Based Midcourse Defense (GMD). The GMD mission is to defend against long-range ballistic missile attacks, using its weapon, the GBI, to defeat threat missiles during the midcourse segment of flight.

Aegis Ballistic Missile Defense (Aegis BMD). The Aegis BMD will provide the capability for Navy Aegis cruisers to use hit-to-kill technology to intercept and destroy short- and medium-range ballistic missiles.

2.1.1.3 Terminal Phase and the Terminal Defense Segment

The ***Terminal Phase*** (see Exhibit 2-5) begins as the deployed warhead or the missile continues along its ballistic trajectory towards trajectory termination.

Exhibit 2-5. Terminal Phase and the Terminal Defense Segment



Terminal High Altitude Area Defense (THAAD) Launch

PATRIOT Advanced Capability (PAC)-3

- Ballistic missile is seconds away from its intended target as it approaches trajectory termination
- BMDS "last line of defense" - defensive systems must be positioned near area to be protected (e.g., city, airfield)
- Terminal phase lasts about 30 seconds
- Key elements: PATRIOT Advanced Capability – 3 (PAC-3), Terminal High Altitude Area Defense (THAAD), Israeli Arrow Weapon System, Multi-national Medium Extended Air Defense System (MEADS)

BMDS elements currently configured or planned for the terminal defense segment include

PATRIOT Advanced Capability-3 (PAC-3). PAC-3 is a mobile and transportable land-based missile defense element that is capable of multiple simultaneous engagements of short- and medium-range ballistic missiles and can operate in electronic countermeasure environments.

Terminal High Altitude Area Defense (THAAD). THAAD is designed to destroy a ballistic missile as it transitions from the mid-course to terminal phase of its trajectory both inside and outside of the atmosphere (in the endo- or exoatmosphere). THAAD is a land-based element that has the capability to shoot down a short- or medium-range ballistic missile and has rapid mobility to provide a means of defense anywhere in the world in a short timeframe.

Arrow Weapon System (AWS). The AWS is a cooperative effort between the U.S. and the Government of Israel to develop a missile defense system to protect the State of Israel and U.S. and allied forces deployed in the Middle East Region. The AWS is a ground-based missile defense system capable of tracking and destroying multiple short- and medium-range ballistic missiles in the terminal phase of their flight.

Medium Extended Air Defense System (MEADS). The MEADS program is a transatlantic cooperative effort between the U.S., Germany, and Italy to develop an air and missile defense system that is strategically transportable and tactically mobile. MEADS will defend population centers, vital assets, and forces by countering short- and medium-range ballistic missile threats in the terminal phase of their flight. MEADS will integrate the PAC-3 hit-to-kill interceptor into a system that can move with and protect forces as they maneuver in combat.

2.1.2 BMDS Functional Capabilities

The ability of the proposed BMDS to achieve a layered defense can be described in terms of ***functional capabilities***. The functional capabilities of the BMDS would be developed with the objective of deploying an initial set of capabilities by 2004-2005 and enhancing these capabilities over time.

Functional capabilities: The capability of the proposed BMDS to detect, identify, track, discriminate, intercept, and destroy a threat ballistic missile during a specific phase of flight (i.e., boost, midcourse, or terminal). Functional capabilities are the abilities to negate specific ballistic missile threats.

The functional capabilities of the proposed BMDS include the long-term flexibility of the BMDS to evolve to meet future threats. To engage a threat, an **engagement sequence** is needed.

> ***Engagement Sequence*:** A unique combination of detect-control-engage functions performed by BMDS components (e.g., sensors, weapons, and C2BMC equipment) used to engage a threat ballistic missile. The command and control, battle management, and fire control functions enable the engagement sequence.

Combinations of these capabilities with common characteristics, called **engagement sequence groups (ESGs)**, may be used to simplify the specification of BMDS capabilities and to more easily assess system performance during testing and operations.

> ***Engagement Sequence Group (ESG):*** The logical categorization of engagement sequences based upon common capabilities or characteristics (e.g., sensors, weapons, and C2BMC equipment) that perform overlapping or similar functions in the execution of an engagement. Using ESGs as a tool enhances functional and engineering analysis, creates manageable combinations for Initial Defensive Operations and Block configurations, simplifies allocation of BMDS capabilities, provides a structure to assess BMDS performance, and assists the warfighter in operating the BMDS.

The BMDS would need to

1. Provide input for missile defense battle management decisions

The BMDS should provide a way to decide when a foreign missile launch poses a threat that warrants a response, what response to take, and when the threat has been negated. The BMDS must be able to obtain the necessary information and provide it to the decision-maker in a timely manner. Functional capabilities needed to provide the information include the ability to

- Detect threat missile launches,
- Determine threat posed by missile (including type of warhead and potential payload),
- Track missile flight path,
- Predict threat impact location(s),
- Communicate with defensive weapons to direct the intercept, and
- Detect/assess the intercept.

2. Negate threat missiles during flight

The BMDS should have the capability to destroy threat missiles anywhere along the flight trajectory. Functional capabilities that the BMDS must have to destroy threat missiles include the ability to

- Launch a defensive weapon,
- Overcome any countermeasures released by a threat missile,
- Guide defensive weapon to critical point,
- Engage threat missile, and
- Negate threat payload.

3. Provide multiple engagement opportunities during flight

The BMDS should provide multiple engagement opportunities along a flight path. Threat missiles evading initial intercept attempts could be negated by subsequent attempts. This capability also provides opportunities to destroy the threat while it is over enemy territory (i.e., during boost) or over sparsely populated areas (i.e., during midcourse flight). Functional capabilities needed to provide multiple engagement opportunities include the ability to

- Coordinate and manage multiple weapon launches,
- Sustain/maintain launch facilities, and
- Engage threat missile in all flight phases.

4. Provide robust defense against evolving threats

The BMDS should have the capability to adjust to a constantly evolving threat environment. Enemies will adjust and develop their offensive tactics and capabilities. Changing political situations may shift where threat missiles may be launched and the theater of operations the BMDS must protect. Functional capabilities that must be developed to defend against evolving threats include

- Interoperable technologies that can work in various combinations, and
- Interoperable technologies that are deployable where needed.

According to the functional capabilities currently identified for the proposed BMDS, the system would detect, identify, track, discriminate, engage, and destroy ballistic missiles in all phases of flight that threaten the U.S. and its deployed forces, allies, and friends. To achieve these functional capabilities, the proposed BMDS would be a system of integrated technologies, or **components,** that are greater than the sum of the current defensive elements. The components of the BMDS are

- Weapons (i.e., interceptors and lasers),
- Sensors (i.e., radars, infrared, optical, and lasers),
- C2BMC, and
- Support Assets (i.e., auxiliary equipment, infrastructure, and test assets).

Individual components can be thought of as “tools” or “building blocks” that could be combined in different ways to meet the required functional capabilities of the proposed BMDS. Components would contribute to the functional capabilities as described in Exhibit 2-6.

Exhibit 2-6. Crosswalk of Functional Capability with Components

FUNCTIONAL CAPABILITY	COMPONENTS			
	Weapons	**Sensors**	**C2BMC**	**Support Assets**
1. Input for Missile Defense Battle Management Decision				
Detect Threat Missile Launches		X		X
Determine Threat Posed by Missile		X	X	X
Track Missile Flight Path		X		X
Predict Impact Location		X	X	X
Communicate with Other Elements and Weapon System	X	X	X	X
Detect/Assess Intercept		X	X	X
2. Negate Threat Missiles During Flight				
Launch Defensive Weapon	X		X	X
Overcome Countermeasures	X	X		X
Guide Weapon to Critical Point	X	X	X	X
Interrupt Missile Flight	X			X
Negate Threat Payload (Lethality)	X			X
3. Provide Multiple Engagement Opportunities During Flight				
Coordinate Multiple Weapon Launches	X	X	X	X

Exhibit 2-6. Crosswalk of Functional Capability with Components

FUNCTIONAL CAPABILITY	COMPONENTS			
	Weapons	**Sensors**	**C2BMC**	**Support Assets**
Engage Threat Missile in All Flight Phases	X	X	X	X
4. Provide Robust Defense Against Evolving Threats				
Interoperability of Components	X	X	X	X
Deployable Where Needed	X	X	X	X

The BMDS functional capabilities would evolve over time in response to newly defined threats and technology developments. As the functional capabilities change, individual components and elements would be enhanced with new technologies to meet those threats. The evolution of the proposed BMDS is described in Section 2.1.3 BMDS System Acquisition Process below.

2.1.3 BMDS System Acquisition Approach

2.1.3.1 Traditional Approach to Missile Defense Acquisition

The system acquisition process for evolving defensive systems historically required defined system architectures. Under the traditional approach, the MDA primarily focused on developing single elements and associated technologies that could provide independent defensive military utility. These stand-alone elements can be characterized as packages of components, typically comprised of sensors, a weapon, accompanying C2BMC hardware and software, and support assets.

The traditional acquisition process focused on developing, testing, and procuring individual elements with certain functional defensive capabilities. However, this process can also require a rigid adherence to a defined life cycle. All components of an element must meet all existing weapons acquisition specific test, development, and operational requirements before the element can be produced and procured. This inflexible process can be redundant and inefficient as technical challenges associated with one component might delay the progress of other components in an element. The initial focus of the DoD on developing and acquiring elements resulted in several NEPA analyses to support the development, testing, and procurement of the proposed defensive elements and their components. Detailed discussions of these elements can be found in Appendix D.

2.1.3.2 New Approach to Proposed BMDS

The MDA, as the acquisition agency for the BMDS, has implemented a new, more flexible approach to developing the proposed BMDS. This approach is capability-driven and component-based rather than focused on specific elements or programs. Capability-based planning allows MDA to develop capabilities and objectives based on technology feasibility, engineering analyses, and the capability of the threat. This development involves an iterative process known as spiral development that refines program objectives as technology becomes available through research and testing with continuous feedback between MDA, the test community, and the military operators. Thus MDA can consider deployment of a missile defense system that has no specified final architecture and no set operational requirements but which will be improved incrementally over time.

MDA's approach to accomplish the goal of developing an integrated, layered BMDS capable of engaging enemy ballistic missiles of all ranges during the boost, midcourse and terminal phases of flight would focus on

- Fielding an initial defensive capability (IDC) in accordance with the President's direction;
- Adding interceptors and networked, forward-deployed ground-, sea- and space-based sensors to make the interceptors more effective in 2006-2007; and
- Adding layers of increasingly capable weapons and sensors, made possible by inserting emerging technologies.

The approach for incremental improvement involves

- Determining functional capability needs,
- Identifying potential ways to meet these needs with new and/or enhanced components,
- Using a spiral development process to develop, test, and identify new technologies, and
- Fielding only those new and/or enhanced components with proven ability to meet the identified functional capability needs.

Spiral development begins when a desired functional capability is identified. The ability of existing components and emerging technologies to meet the functional capability would be reviewed and efforts to develop or enhance specific components would be initiated. Testing and ongoing modification would be used to determine the ability of each component to meet the functional capability needs. For example, new components would undergo initial development or proof-of-concept testing, while existing components would be tested to determine their readiness for use. Work on a given technology improvement would stop if testing failed to demonstrate effectiveness or functional capability needs changed.

The process is organized into two-year time windows, or **Blocks**, consisting of packages of capabilities that are being developed over several years. For example, Block 2004 represents years 2004-2005, and Block 2006 represents years 2006-2007. During each Block, the MDA would research, develop, and test components in varying stages of development.

> ***Block***: A block is a two-year increment of the BMDS providing an integrated set of capabilities, which has been rigorously tested as part of the BMDS Test Bed and assessed to adequately characterize its military utility. The configuration for each block is drawn from the prior BMDS Block; BMDS elements, components, technologies, and concepts; C2BMC architecture; and externally managed systems, elements or technologies.

Thus, the development and testing of individual components to meet a specific BMDS functional capability would "spiral" through several successive Blocks (see Exhibit 2-7). When appropriate, spiral development within block increments would help keep pace with useful technology improvements, reduce risk through iterative reviews, and match user expectations with delivered performance to provide improved capabilities as quickly as possible. Eventually, some components would be transitioned to the military service responsible for deployment, operation and maintenance. Evolutionary acquisition in block increments would provide a practical approach to aggressively develop and field early BMDS capabilities while preserving flexibility to respond to evolving ballistic missile threats and incorporate improved technology.

Exhibit 2-7. Block Development Process

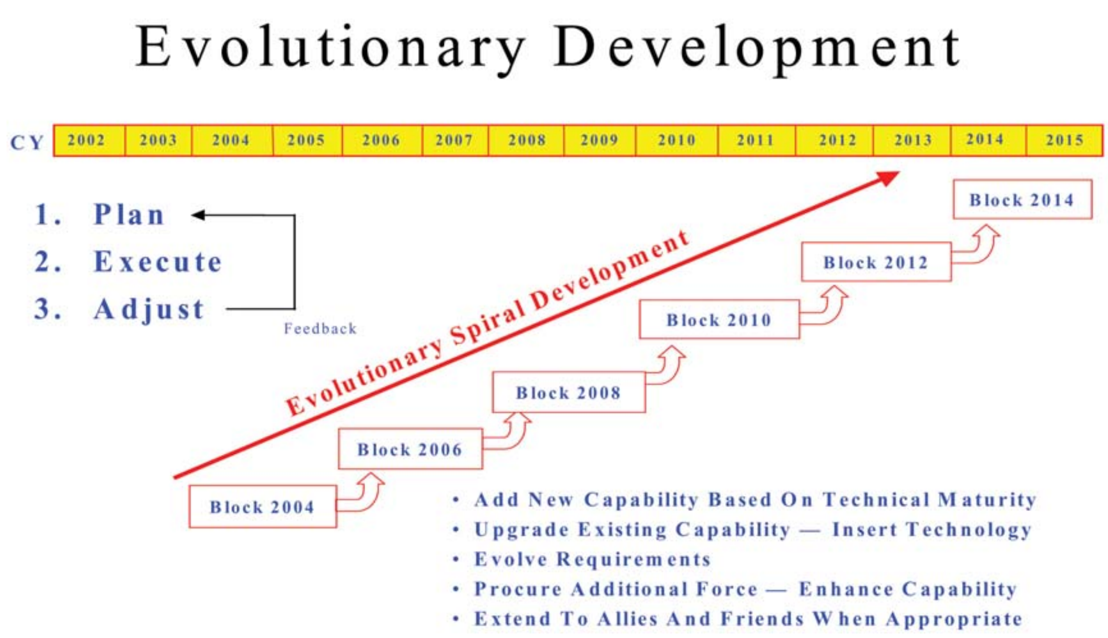
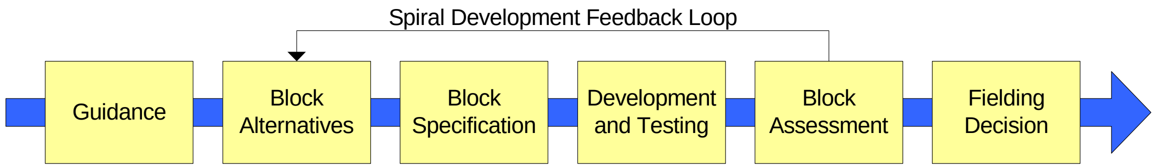


Exhibit 2-8 shows spiral development via the systems engineering process.

Exhibit 2-8. The MDA Systems Engineering Process



The engineering principle for organizing and discussing the BMDS capability is the ESG, which is a means to categorize or group similar engagement sequences based on capability or function. An engagement sequence is a unique combination of detect-control-engage functions performed by BMDS components used to engage a threat ballistic missile; it would define a specific detection sensor, specific fire control radar and specific weapon. ESGs define the sequence of events, functions, and system components used to enable a weapon to engage a target and provide the structure for measuring the level of performance and integration maturity of the BMDS. ESGs also relate multiple ways of engaging a target.

An example of an ESG is an intercept scenario in which the GBI would receive its final target update from the COBRA DANE Radar. As the BMDS grows in complexity, i.e., integration of many elements and components, the number of ESGs will increase, thereby increasing system capability. Better information about the threat from additional sensors and more chances to destroy the threat from additional weapons will also result in enhanced system performance. Using ESG as a tool enhances functional and engineering analysis creates manageable combinations for Block configurations, simplifies allocation of BMDS capabilities, provides a structure to assess BMDS performance, and assists the warfighter in operating the BMDS.

2.2 BMDS Components

The components of the proposed BMDS are weapons, sensors, C2BMC, and support assets that as part of the existing or envisioned elements can provide the functional capabilities of the BMDS. The proposed BMDS would integrate components in a unified system. The general characteristics of these components are described in the following sections. Descriptions of components of existing elements are provided in Appendix D.

2.2.1 Weapons

Weapons are the components of the BMDS that can be used to destroy threat missiles. For the BMDS, weapons consist of various types of interceptors and directed energy weapons (e.g., high energy lasers [HELs]). Interceptors would use two primary kinetic energy technologies, hit-to-kill or direct impact and directed fragmentation.

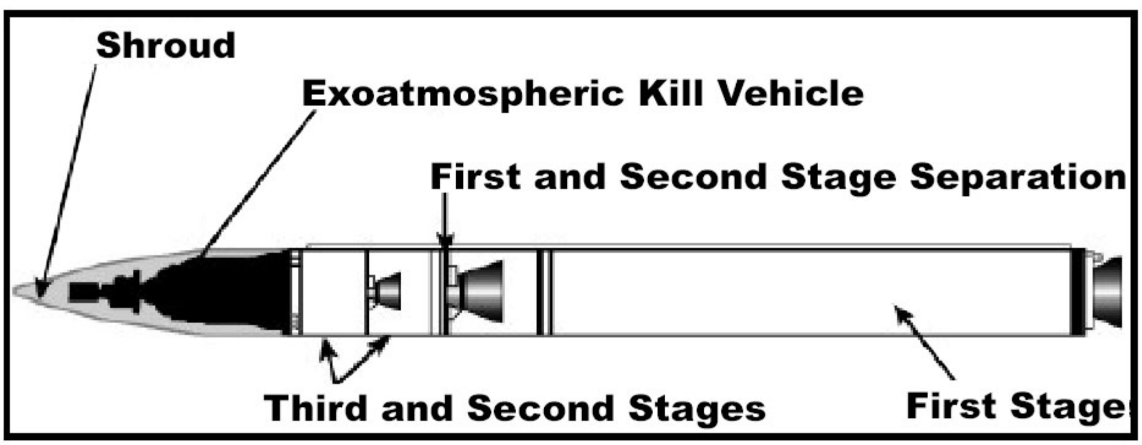
Interceptors must conduct multiple tasks simultaneously, adjust flight path accurately, discriminate the reentry vehicle from countermeasures, and engage and negate the threat missile. BMDS interceptors could be placed on land, sea-, air-, or space-based platforms. BMDS directed energy systems are currently envisioned to perform target illumination and tracking and to negate threat missiles from an air-based platform, although they could also be placed on land-, sea-, or space-based platforms.

2.2.1.1 Weapons Technologies and Subcomponents

Interceptors

Interceptors use kinetic energy either in a direct impact or hit-to-kill mode, or to deflect or possibly destroy a threat missile by directed blast fragmentation. Interceptors are composed of two primary parts, a booster and a kill vehicle (see Exhibit 2-9). An interceptor may have one or more boosters (also called stages). The number of boosters or stages refers to the number of rocket motors that sequentially activate. Multiple stages allow the interceptor to fly at higher velocities and altitudes, and for longer distances. The kill vehicle is the portion of the interceptor that performs the intercept and destroys the threat missile. It is anticipated that solid and liquid propellants would be used in the boosters and in the kill vehicles. For the purposes of this PEIS, interceptors will be discussed and analyzed for environmental impacts at the booster and kill vehicle level. This will allow the MDA the flexibility to configure new interceptors based on boosters and kill vehicles analyzed in this document to address new or emerging threats.

Exhibit 2-9. Interceptor Schematic



Interceptors may also use lethality enhancers, seekers, and attitude control systems. Lethality enhancers are non-nuclear explosive devices that increase the probability of destroying the threat missile and its payload (e.g., explosives, chemical or biological agents). Seekers help to detect the threat missile and home in on it. Attitude controls are small motors used to modify the flight path of the kill vehicle and position it into the

flight path of the threat missile. All of these are important parts of interceptors and the environmental impacts from their use will be considered as part of the analysis of boosters and kill vehicles in this PEIS.

Boosters use two broad classes of propellants: solid and liquid. Propellants consist of a fuel and oxidizer. An oxidizer is a substance such as perchlorate, permanganate, peroxide, and nitrate that yields oxygen readily to support the combustion of organic matter, powdered metals and other flammable material. Boosters can use liquid hydrocarbon propellants (e.g., kerosene) plus an oxidizer such as liquid oxygen; cryogenic propellants (e.g., liquid oxygen or liquid hydrogen [H_2]) where the fuel and oxidizer are maintained at very low temperatures; hypergolic propellants (e.g., hydrazine [fuel] and nitrogen tetroxide [oxidizer]) where mixing the fuel and oxidizer ignites the engine without requiring an external ignition source; or solid propellant (e.g., polybutadiene matrix, acrylonitrile oxidizer and powdered aluminum). Solid rocket motors can also be used as external motors to supplement the thrust of the first stage of an interceptor. Some propellants such as hydrogen peroxide can be used in concentrated form as a monopropellant or in conjunction with other propellants.

Interceptor Technology

As mentioned above there are two major kinetic energy technologies employed by interceptors, hit-to-kill and directed blast fragmentation.

Hit-To-Kill

Hit-to-kill technology relies on high closing speeds of an interceptor to collide with and destroy the threat missile. The interceptor uses kinetic energy, that is, the force of the collision, to destroy the threat warhead. Most of the BMDS elements, e.g., GMD, Aegis BMD, THAAD, and PAC-3, use this interceptor technology. Exhibit 2-10 shows an example of an interceptor launch.

Exhibit 2-10. Interceptor Launch

Directed Blast Fragmentation

Directed blast fragmentation technology involves the interceptor approaching the threat ballistic missile and exploding close to it, thereby disrupting the path of the threat missile and possibly destroying it. The interceptor does not actually collide with the threat ballistic missile. A directed blast fragmentation kill vehicle explodes near the threat missile and distributes its fragments over a large area to create a kill zone around the path of

the threat missile. As the quickly moving threat missile enters the kill zone it collides with the fragments, which alter its path and potentially destroy the threat missile altogether. Arrow and PATRIOT systems currently include this technology.

Lasers

Laser use directed energy to destroy threat ballistic missiles. High mobility and speed-of-light intercept are key aspects of directed energy weapons. The ABL element currently uses this laser technology.

A megawatt class chemical HEL is being developed as part of the BMDS boost phase defense system. HEL devices are laser systems that use high speed flowing gas or large amounts of electrical power, or combinations of the two, to produce directed beams of energy. The chemical oxygen iodine laser (COIL) is one of three lasers under consideration to be integrated into the BMDS. The COIL operates by creating chemical reactions between chlorine gas and a mixture of hydrogen peroxide and alkali metal hydroxides. The chemical reactions produce a form of oxygen (singlet delta) that is used to transfer the energy to atoms of iodine. The iodine, in turn, releases this energy as light, which is then focused by mirrors and lenses into a laser beam. The COIL has four primary parts: oxygen generator, gain generator (or resonator), pressure recovery system, and storage tanks that hold all the chemicals needed to operate the laser. Directed energy from the laser weapon would heat the threat missile body canister causing overpressure and/or stress fracture, which would destroy the missile. The HEL could be mounted on an aircraft and flown at high altitudes to detect, track, and destroy threat missiles in the boost phase.

2.2.1.2 Weapons Basing Platforms

There are four primary weapons basing platforms considered in this PEIS: land, air, sea, and space. Some of the interceptor and laser technologies could be based on more than one type of platform while others might be based on only a single platform. The basing platform for a weapon would affect the impact that the weapon has on the environment. The weapons basing platform may also affect the phase of flight in which the weapon can intercept a threat missile. The description and analysis of the support equipment and infrastructure associated with the fixed weapons basing platforms (e.g., missile silos, launch pads, sled tracks) and the mobile weapons basing platforms (e.g., mobile launchers, aircraft, ships, satellites) are presented under Support Assets, equipment and infrastructure, respectively.

Land-based Platforms

Land platforms would be either fixed or mobile. The fixed land platforms would include missile silos, launch pads, and launch stools from which interceptor missiles could be launched. Sled tracks and engine test stands could be used to test motors for interceptors or conduct GTs of directed energy weapons. Mobile land platforms currently include mobile launchers mounted on trucks or trains and moved into the desired location. The following BMDS weapons would use land platforms: KEI, GBI, THAAD, PAC-3, AWS and MEADS.

Air-based Platforms

Air platforms would include balloons and aircraft of various types and sizes. The ABL is currently the only proposed BMDS element with a weapon using an air platform, i.e., the HEL.

Sea-based Platforms

Sea platforms would be either fixed or mobile. The fixed platforms would include man-made islands or vessels anchored to the sea floor. The mobile platforms would be either self-propelled or moved or towed via a tug vessel. These could include ships, submarines, and other sea-faring vessels (e.g., platforms not anchored to the sea floor). The KEI and the Standard Missile (SM) are currently the proposed BMDS weapons using a sea platform.

Space-based Platforms

Space platforms would carry sensors and/or weapons and would be carried into space by launch vehicles. Once released by the launch vehicle, the space platform would maneuver into the appropriate orbit around the Earth using on-board propulsion systems. The platforms could be maneuvered into several different types of orbits including Geosynchronous Earth Orbit (GEO), which allows the platform to remain positioned over one location on the Earth, and Low Earth Orbit (LEO), which allows the platform to be positioned over various parts of the Earth at different times. The space platforms would maintain their orbit by using on-board propulsion systems for the duration of their useful life. The proposed KEI and space-based lasers are types of weapons that could use a space platform.

2.2.2 Sensors

Sensors are the tools that function as the "eyes and ears" of the BMDS. BMDS sensors would provide the relevant incoming data for threat ballistic missiles. Detailed sensor descriptions can be found in Appendix E. The data from these sensors would travel

through the communication systems of the proposed BMDS to Command and Control (C2) where a decision would be made to employ a defensive weapon such as launching an interceptor. The BMDS sensors would provide the information needed to determine the origin and path of a threat missile to support coordinated and effective decision-making against the threat. Additionally, these sensors would provide data on the effectiveness of the defense employed, that is, whether the threat has been negated.

BMDS sensors would be developed or enhanced to acquire, record, and process data on threat missiles and interceptor missiles; detect and track threat missiles; direct interceptor missiles or other defenses (e.g., lasers); and assess whether a threat missile has been destroyed. These sensors (i.e., radar, infrared, optical, and laser) would include signal-processing subcomponents, which receive raw data and use hardware and software to process these data to determine the threat missile's location, direction, velocity, and altitude. This and other relevant information would then be integrated into planning and controlling intercept engagements through the C2BMC component of the BMDS. For the purposes of this PEIS, the analysis of sensor systems will focus on the emissions power and range of the sensor categories to determine which sensors have the most potential for environmental impacts.

The three general categories of sensors considered in this PEIS include

- **Weapon/Element Sensors**. These sensors are part of the individual weapons and elements and allow them to operate independently from the overall BMDS. An example of this type of sensor is the PATRIOT radar. Although weapon/element sensors are designed for independent utility, they would also have the capability to function as an integrated part of the BMDS both in a testing or deployment scenario. For example, the ABL sensors could serve as forward sensors for the BMDS and could be used during testing to provide target information to midcourse and terminal phase weapon components. Discussion of sensors in this category is found under the individual Weapon/Element discussions in Appendices D and E of this PEIS.

- **BMDS Mission Sensors.** These are radar and optical sensors that are not part of an element but would provide data essential to the functional capabilities of the BMDS. These independent sensors would provide information for missile warning, early interceptor commit, in-flight target updates, and target object maps through the BMDS C2BMC architecture to the BMDS and its components. The MDA would include these existing sensors in testing activities either as part of the BMDS architecture or to evaluate a test of other parts of the BMDS architecture. For example, an EWR, such as the Position and Velocity Extraction Phased Array Warning System (PAVE PAWS), could be used to identify an ICBM target and provide cueing information to a midcourse sensor, such as SBX, to test sensor interoperability.

- **Test Range Telemetry Sensors.** These are the sensor systems used to acquire, record, and process data on targets and interceptor missiles during testing on a test range. They detect and track targets, observe defensive weapons, and assess whether a target has been destroyed. They also support range safety activities by providing test operators with information on whether the range is clear of non-test participants (i.e., recreational boats, private aircraft, etc.) and the test is proceeding within planned parameters. These sensors are not part of the actual BMDS, but are considered part of the BMDS Test Bed. Test range telemetry sensors include fixed sensors at test range facilities and mobile sensors at test range facilities or on ships or aircraft. Mobile sensor capabilities add flexibility for testing while minimizing fixed infrastructure investment. The description and analysis of such sensors are presented under Support Assets - Test Assets.

Sensors can also be described in terms of the technologies employed in the various sensor types as discussed below.

2.2.2.1 Sensor Technologies

The technologies used by the existing and proposed BMDS sensors fit into four basic categories, ***radar***, ***infrared***, ***optical***, and ***laser***, based on the frequency or electromagnetic (EM) energy spectrum used by the sensor.

Radar Technology

Radar, which stands for **RA**dio **D**etection **A**nd **R**anging, typically is an active sensor that emits radio frequency energy toward an object and measures the energy of radio waves reflected from the object. Radars are currently based in land and sea operating environments. Most modern radars operate in a frequency range of about 300 megahertz (MHz) to 30 gigahertz (GHz), which corresponds to a wavelength range of one meter to one centimeter. The time delay in the return signal or echo allows the determination of distance to the object and the change in the frequency of the echo through the Doppler Effect allows the determination of the object's speed. The Doppler Effect is the shift in frequency resulting from relative motion of an object in relation to, in this case, the radar. Most current radars are mono-static because the transmitter and receiver are collocated. There are also radars with multiple transmitters and multiple receivers in different locations that are called bi-static and multi-static radars based on the number of transmitters and receivers. Exhibit 2-11 summarizes the wavelengths and frequencies of radar bands.

Exhibit 2-11. Radar Band Designations

Band	Wavelength Ranges	Frequency Ranges
High Frequency	100-10 meters (328-33 feet)	3-30 MHz
Very High Frequency	10-1 meters (33-3.3 feet)	30-300 MHz
Ultra High Frequency	1 meter-10 centimeters (3.3 feet-4 inches)	300-3,000 MHz
L band	30-15 centimeters (12-6 inches)	1-2 GHz
C band	15-7.5 centimeters (6-3 inches)	2-4 GHz
S band	7.5-3.75 centimeters (3-1.5 inches)	4-8 GHz
X band	3.75-2.50 centimeters (1.5-1 inches)	8-12 GHz
Ku band	2.5-1.67 centimeters (1-0.66 inches)	12-18 GHz
K band	1.67-1.11 centimeters (0.66-0.44 inches)	18-27 GHz
Ka band	1.11-0.75 centimeters (0.44-0.30 inches)	27-40 GHz
W band	3 millimeters (0.12 inches)	95 GHz
Mm band	-	110-300 GHz

Infrared Technology

Exhibit 2-12. DSP Satellite

Infrared sensors detect the heat energy or infrared radiation from an object. Infrared electromagnetic radiation (EMR) has wavelengths longer than the red end of visible light and shorter than microwaves (roughly between one and 100 microns). The Defense Support Program (DSP) satellite, as shown in Exhibit 2-12, is an example of a space-based infrared sensor (SBIRS) that can detect the heat signature or plume from the launch of a ballistic missile.

Optical Technology

Optical sensors operate in the **visible** range and are generally passive sensors that detect objects or missiles by collecting light energy or radiation emitted from the target in wavelengths visible to the human eye. Specifically, the human eye perceives this radiation as colors ranging from red (longer wavelengths, approximately 700 nanometers) to violet (shorter wavelengths, approximately 400 nanometers). The planned Space Tracking and Surveillance System (STSS) satellites, for example, would have both infrared and optical sensors.

Laser Technology

Laser is an acronym for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation. Laser sensors use laser energy of various energy levels and frequencies (ultraviolet, visible) to illuminate an object to detect the object's motion. Like radar, a laser-based sensor is an active sensor that sends out laser energy toward an object and then receives a return echo from the object. The time delay in the return signal or echo allows the determination of distance to the object and the change in the frequency of the echo through the Doppler Effect allows the determination of the object's speed. The ABL aircraft uses passive infrared sensors to detect, and laser sensors to illuminate and track threat ballistic missiles.

2.2.2.2 Sensor Operating Environments

The operating environments of the existing and proposed BMDS sensors can be considered in four general categories. **Land-based** sensors may be fixed, located in or on a building, or mobile, located on a vehicle or trailer. **Air-based** sensors are located on platforms that can travel through the air such as airplanes, balloons, and airships. **Sea-based** sensors are located on platforms that travel on water (e.g., ships or a floating platform) or are fixed in water (e.g., a man-made island or platform like an oil platform that is fixed to the seafloor). **Space-based** sensors are located on satellites, which travel in circular or elliptical orbits around the Earth. These satellites can be in several different types of orbits including GEO, which is an orbit at approximately 36,000 kilometers (21,700 miles), synchronized with the Earth's rotation, and LEO, which is an orbit at an altitude of approximately 160 to 1,600 kilometers (100 to 1,000 miles). Weather, communications, and some military satellites, such as DSP satellites, typically use GEO orbits.

The following exhibit outlines many of the current and proposed sensors that would or could be developed to provide the BMDS with the required sensor functionality. Exhibit 2-13 includes the proposed operating environment or current proposed location for each of the sensor types.

Exhibit 2-13. Proposed Sensors, Roles and Operating Environments

Sensor	Primary Function	Operating Environment
ABL Infrared Search and Track (IRST)	Infrared Sensor	Airborne
ABL-Active Ranging System (ARS)	Laser Sensor	Airborne
ABL-Beacon Illuminator Laser (BILL)	Laser Sensor	Airborne
ABL-Track Illuminator Laser (TILL)	Laser Sensor	Airborne
Advanced Research Project Agency Lincoln C-band Observable Radar (ALCOR)	Tracking Radar	Fixed land-based
Aegis SPY-1 Radar	Fire Control Radar	Mobile sea-based
Arrow Fire Control Radar	Warning and Fire Control Radar	Mobile land-based
Forward-Based X-Band Radar Transportable (FBX-T)	Tracking and Discrimination Radar	Mobile land-based
Ballistic Missile Early Warning System (BMEWS)	EWR	Fixed land-based
COBRA DANE	EWR	Fixed land-based
U.S. Naval Ship Observation Island	Radar	Mobile sea-based observation platform
DSP	Infrared Sensor	Space-based
Ground Based Radar Prototype (GBR-P)	Fire Control Radar	Fixed land-based
Innovative Science and Technology Experimentation Facility (ISTEF)	Optical and laser sensors	Land-based sensor experimentation facility
ISTEF Mobile Sensors	Optical and laser sensors	Mobile sensor systems based at ISTEF
Maui Space Surveillance System (MSSS) [a.k.a. AMOS]	Optical Infrared Sensor	Fixed land-based
MEADS Surveillance Radar	Warning and Fire Control Radar	Mobile land-based

Exhibit 2-13. Proposed Sensors, Roles and Operating Environments

Sensor	Primary Function	Operating Environment
PATRIOT Radar	Warning and Fire Control Radar	Mobile land-based
PAVE PAWS Radar	Early Warning Radar	Fixed land-based
SBX	Tracking and Discrimination Radar	Mobile, sea-based platform
STSS	Infrared Sensor	Space-based
SBIRS-High	Infrared Sensor	Space-based
THAAD Radar	Warning and Fire Control Radar	Mobile land-based
Transportable System Radar (TPS-X)	Instrumentation Test Bed Radar	Mobile land-based

2.2.3 Command and Control, Battle Management, and Communications (C2BMC)

C2BMC would provide the rules, tools, displays and connectivity to enable the proposed BMDS to engage threat missiles. C2BMC would be the overall integrator of the BMDS. C2BMC would consist of electronic equipment and software that enable military commanders to receive and process information, make decisions, and communicate those decisions regarding the engagement of threat missiles (see Exhibit 2-14). This would include computer workstations installed in existing infrastructure at certain locations, and may include new fiber optic cable, radios, and satellite communications.

Exhibit 2-14. Typical Command Center

C2BMC would be designed and built to provide war fighters with the capability to effectively plan and execute the MDA's mission. C2BMC would integrate and expand existing capabilities that provide the flexibility to exploit a wide range of tactics, techniques and procedures and BM options. The goal of C2BMC is to achieve seamlessness in a layered defense through coordinated C2 and integrated fire control.

Specifically, C2BMC would receive, process, and display tracking and status data from multiple elements, components and sensors so that local commanders at various locations would have the same integrated operating picture and could make coordinated decisions about deploying weapons. This would allow the central command structure to use the most effective weapons to engage threat ballistic missiles in all flight phases.

The BMDS C2BMC includes three primary parts, Command and Control (C2), Battle Management (BM), and Communications that would operate in an integrated fashion across all BMDS components.

- **C2** would provide a flexible, integrated architecture to plan, direct, control and monitor BMDS activities. C2 would provide decision-aid applications that integrate information and recommendations for defensive options in near real-time to develop the operational war fighting aids required for formulating and implementing informed decisions and reduce decision cycles. This would permit quick redirection and reallocation of assets based on rapidly changing situations and threats. C2 also would integrate the Unified Commands, North Atlantic Treaty Organization and other allies, friends, and other external systems to which C2 would connect.

- **BM** would control the launching or firing of missiles and integrate the kill chain functions (surveillance, detect/track/classify, engage and assess) across the layered defenses (boost, midcourse and terminal). Initially, BM would provide the means for executing preplanned responses by integrating available information to provide near real-time tasking and status. As the BMDS evolves, BM would evolve to provide the user with increased automation, capability, and ability to integrate information from increasingly diverse resources. Advancements in BM are intended to further increase the battle space with continued improvements in tracking and discrimination information, sensor netting, operability with coalition partners, near real time intelligence, battlefield learning and dynamic planning, and integrated BM execution using disparate sensors and firing units.

- **Communications** would allow all BMDS components to exchange data and network with BMDS assets. The goal of BMDS communications is to provide robust networks that manage the dissemination of the information necessary to perform the C2 and BM objectives. The communications networks would seamlessly connect BMDS components and link them with other applicable DoD and non-DoD networks and assets as required. The network infrastructure would make optimal use of existing data and information conduits and protocols.

The long-term development of the C2BMC would begin with planning and monitoring the autonomous operation of elements with stand-alone capability and expand to the centralized and integrated control of the BMDS. Currently, each BMDS element, such as THAAD, PAC-3, or ABL operates or is designed to operate as an autonomous unit, each

with stand-alone capability and with its own BM, C2 and communications system (i.e., element-specific BMC3). C2BMC would fuse the data of these BMC3 components by integrating communications to provide a more robust picture of the operational arena. Individual element weapon system component descriptions can be found in Appendix D.

For example, a BMDS element like the PAC-3 has an internal or organic BMC3 component that transfers needed data from its data-gathering sensors (e.g., satellites and radars) to its local military commander. Using the information, the local military commander can make a BM decision to launch a weapon at the incoming threat ballistic missile. The BMDS C2BMC would capture and display tracking and status data from multiple existing and proposed weapon systems' BMC3 systems and sensors so that local commanders at various locations would have the same integrated operating picture and could make coordinated decisions about deploying weapons. C2BMC would include existing and new land-, sea-, air- and space-based C2BMC systems.

In an integrated BMDS, C2BMC would ensure interoperability with other BMDS components in reacting to the threat. For example, if an ABL sensor identifies the presence of an incoming ballistic missile, the information would be transmitted to the BMDS C2BMC. In coordination with other incoming information across the BMDS, a decision could be made that an Aegis cruiser launching a Standard Missile-3 (SM-3) would be the most effective element to engage and negate the threat missile. The commander of the cruiser would have real-time knowledge of the decision to quickly launch an SM-3 interceptor against the threat missile.

The MDA plans to improve the internal BMC3 capabilities of each BMDS element and to develop and continually upgrade the overall BMDS C2BMC. New or additional sensors and communications nodes would be incorporated, as well as new target discrimination algorithms, as they are developed.

Various U.S. command centers would eventually house a C2BMC node. A node is a set of equipment and processes that performs the communications functions at the end of the data links that interconnect those elements, which are resident on the networks. C2BMC nodes are located at geographically dispersed facilities and receive and display tracking and status data from multiple BMDS components so that local commanders can make coordinated decisions about deploying weapons. Each node consists of electronic equipment, software, computer workstations, radios, fiber optic cables, and communication devices. Nodes at various locations integrate and communicate data using this hardware and software to support C2 and BM activities. Each of these nodes would receive and display the same data to local commanders so that they can make coordinated decisions about weapons use.

2.2.4 Support Assets

Support assets are comprised of auxiliary equipment, infrastructure, and test assets that facilitate BMDS operations. Some of the support equipment (e.g., tracking stations and data processing systems) and infrastructure (e.g., test ranges and launch facilities), and all test assets comprise the BMDS Test Bed. They enable BMDS components to operate at maximum effectiveness over an extended useful life. Assets that support BMDS components include mobile equipment, such as cooling systems, power generators, and operator control units as well as fixed infrastructure such as docks and shipyards, launch facilities, airports and air stations, and communication facilities. Support assets as described above will be analyzed separately from their associated component.

Test assets used for component and system testing and deployment purposes include mobile equipment, infrastructure, and other equipment (e.g., target missiles). Although these test assets are not components of the BMDS, they are critical to its effective development and demonstration. Typical test assets would include test range facilities, targets, countermeasure devices, test sensors, optical and infrared cameras, computers, and observation vehicles (e.g., aircraft, ship, trucks, etc.). These test assets are designed to simulate a threat missile in a realistic environment and to assess and enhance the performance of BMDS components in negating those threats.

2.2.4.1 Equipment

The MDA would use a variety of equipment to support the functioning of BMDS components. Interceptors may require generators, fuel tanks, lightning protection, and security surveillance systems. Some weapons elements have mobile launchers such as the THAAD's modified M-1120 Heavy Expanded Mobility Tactical Truck-Load Handling System Palletized Load System launcher, as presented in Section 2.2.1.2, Weapons Basing Platforms. Support equipment for the ABL includes chemical transfer and recovery receptacles to capture laser chemicals from the aircraft and cooling systems for the laser. Existing aerospace ground equipment at each air base would be utilized where possible to support the ABL aircraft, as needed (e.g., generator to run the aircraft's electrical system). Sensors require antenna equipment units, electronic equipment units, cooling equipment units, and prime power units. These units are housed on separate trailers interconnected with power and signal cabling, as required.

Mobile assets also may include trucks, telemetry vans, personnel trailers, rail cars, aircraft, ships, ocean tugs or barges. For each testing event or deployment location, the MDA would use these vehicles to transport the component, test assets (i.e., targets, sensors, telemetry, etc.), and personnel to the site.

2.2.4.2 Infrastructure

Infrastructure that supports the functions of BMDS components includes docks, shipyards, rocket and missile launch facilities, airports/air stations, and communication facilities. These facilities serve as a base of operation from which components begin their missions and return for maintenance, repair, or storage. The MDA would use existing facilities to the extent possible to minimize the need for new construction. Specific types of facilities that would support the BMDS are discussed below.

Docks and Navy Bases

Sea-based components (e.g., Aegis BMD configured ships, mobile launch platforms, transportable telemetry stations) would operate from existing U.S. Navy bases near deployment locations, and possibly other Federal, state and local assets if required. Sea-based platforms for sensors (e.g., SBX platform, mobile launch platform) would be launched from a base and transported to deployed locations at sea. Periodically, the platform would return to primary support base for repairs, maintenance, or upgrades. The operation of the SBX platform has been considered in the GMD ETR EIS.

Launch Facilities and Ranges

The MDA would use existing launch facilities like those at Cape Canaveral Air Station, the National Aeronautics and Space Administration's (NASA's) Kennedy Space Center and Wallops Flight Facility, Vandenberg AFB and the Kodiak Launch Complex (KLC) to launch test and defensive operational assets into orbit. As appropriate, test launch activities could also take place from these facilities. The MDA activities at these launch facilities would be the same as those for other non-BMDS launches at a DoD or NASA launch facility. Other test ranges, e.g., White Sands Missile Range (WSMR), Pacific Missile Range Facility (PMRF), Ronald Reagan Ballistic Missile Defense Test Site (RTS), etc., would continue to be used for various test events involving interceptor and/or target launches. These ranges and facilities comprise the BMDS Test Bed.

Airports and Air Stations

The MDA would use existing military airports and air stations as a base for operation of airborne components including airborne sensors and weapons. The suite of MDA airborne sensors would be installed and operated in modified civilian and military aircraft, which have the capability to land and takeoff from any large airport. The aircraft would use both contractor and military facilities. Hangars and maintenance facilities at the home air base would be used to maintain the airborne sensors.

Communication Facilities

The MDA would use the existing communication facilities (e.g., C2BMC nodes, transmission towers, and repeaters) located at existing military service installations, launch facilities, ranges, air stations, and on other federally owned or leased property. BMDS development, testing, and integration might require the modification of existing communication facilities, or the construction of new communication facilities within or outside such areas.

2.2.4.3 Test Assets

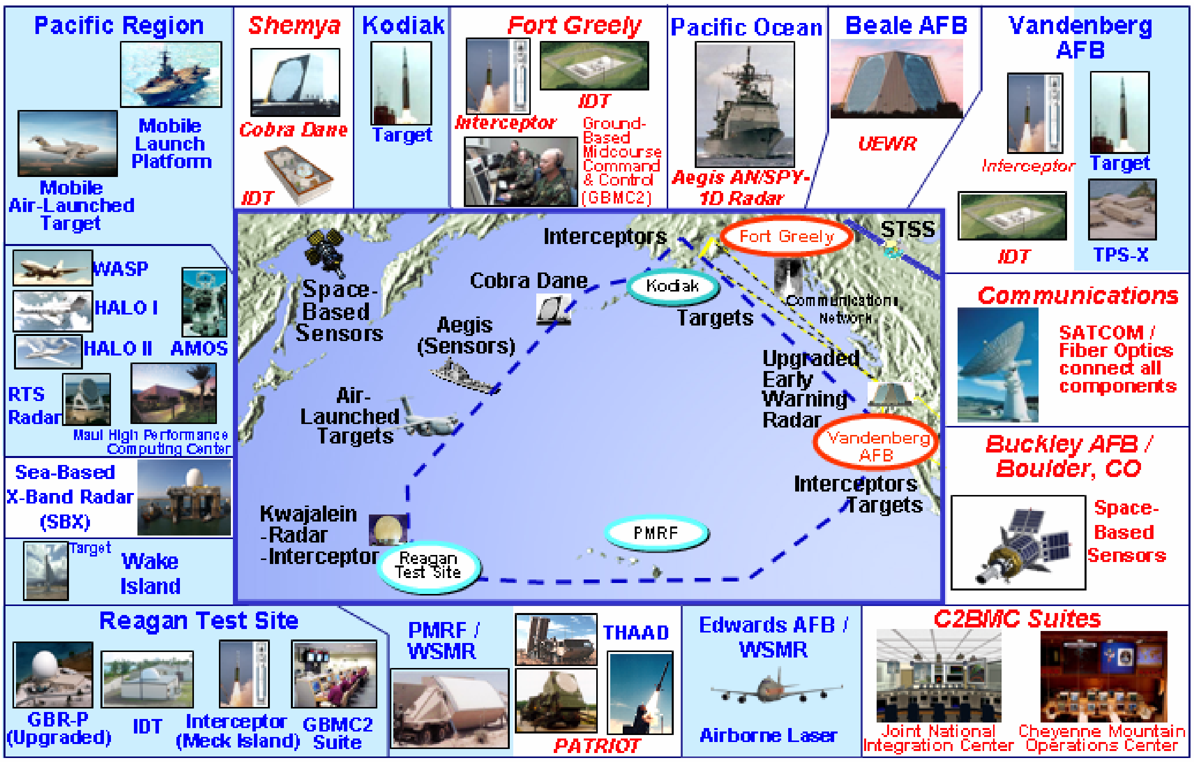
Test assets are not components of the BMDS but are support assets critical to its effective development and testing. Typical test assets would include test range facilities that make up the BMDS Test Bed, sensors used only for test purposes, targets, countermeasure devices, and warhead simulants. Test assets are designed to enhance the BMDS by simulating a threat missile in a realistic environment and to assess the performance of BMDS components in negating those simulated threats. The development and use of countermeasures and simulants in the BMDS test program are part of MDA's Measurement Program as identified in Section 2.2.5. In analyzing impacts of implementing the BMDS in Section 4, countermeasures and simulants will be considered as part of the test portion of the acquisition life cycle as part of Support Assets – Test Assets.

Test Bed

The BMDS Test Bed encompasses the infrastructure and environment where testing takes place. It provides a collection of integrated development hardware, software, prototypes, and surrogates, as well as supporting test infrastructure (e.g., instrumentation, safety/telemetry systems, and launch facilities) configured to support realistic development and testing of the BMDS. Exhibit 2-15 depicts key components of the BMDS Test Bed. The infrastructure primarily provides GT facilities, range and range instrumentation, and mobile sensors. The existing BMDS Test Bed infrastructure components that support testing as a secondary purpose (e.g., COBRA DANE and the EWR National Energy Technology Laboratory) are described under their respective component (e.g., sensors). A major focus is to develop infrastructure that enables realistic testing by permitting realistic geometries for sensor viewing and interceptor engagements. The Test Bed includes test locations already being used, such as GT sites, or already developed, such as the GMD ETR in the Pacific Ocean. In addition, testing could occur from existing operationally deployed sites in compliance with all applicable Federal, state, and local regulations. The MDA may also develop test beds in other areas such as the Atlantic Ocean, Gulf of Mexico, or outside the continental U.S. to support testing of BMDS components in those areas. In 2012, MDA contemplates the development of a space-based test bed; however, the concept is too speculative to be

analyzed in this PEIS. The BMDS Test Bed provides opportunities to use several target and interceptor missile trajectories that encompass a range of missile threats. Test Bed activities help wargames prove out doctrine; operational concepts; tactics, techniques, and procedures; and concept of operations (CONOPS) in militarily relevant environments.

Exhibit 2-15. BMDS Limited Defensive Capability Block 2004 Test Bed



BMDS Test Bed Components Providing *Limited Defensive Capability are Shown in Red Italicized Font.*

MDA's limited defensive capability (LDC) includes the BMDS components having a limited, combat capability to defeat adversary threats. The LDC allows Combatant Commanders use of the BMDS, to refine operational tactics, techniques, and procedures and exercise command control functions while maintaining a missile defense test and development program. For more discussion of BMDS fielding and deployment see Sections 2.3.3 and 2.3.1.1, respectively.

Test Sensors

The technology and operating environments for test range telemetry sensors, radars, and light detection and ranging (lidar) sensors are the same as the technology and operating environments of the element sensors and the BMDS mission sensors described in Section 2.2.2. During test planning, the MDA would identify the appropriate sensor that would provide the necessary location and functions to support achievement of the test

objectives. BMDS mission sensors and test range telemetry sensors as well as radars and lidars would be returned to their normal non-BMDS mission after each test event. Test sensors would be analyzed for environmental impacts in the same manner as described for weapons and mission sensors. Exhibit 2-16 provides information on representative test sensors that are available for use in BMDS testing. These sensors are further described in Appendix E.

Exhibit 2-16. Summary of Representative Test Sensors

Sensors	Type	Test Telemetry	Operating Environment
Advanced Missile Signature Center	Optical sensors	X	Fixed land-based facility
Air Force Research Laboratory (AFRL) Mobile Atmospheric Pollutant Mapper Carbon Dioxide (CO_2) Lidar	Test Lidar		Mobile land-based
AFRL Ka-Band Radar	Test Radar		Mobile land-based
AFRL Mobile Lidar Trailer	Test Lidar		Mobile land-based
ALTAIR	Test Radar	X	Fixed land-based
AN/FPQ-10 Upgraded	Test Radar	X	Fixed land-based
AN/FPS-16	Test Radar	X	Fixed land-based
AN/MPS-25 AN/MPS-25 (upgraded)	Test Radar	X	Fixed land-based
AN/MPS-36	Test Radar	X	Mobile land-based
AN/MPS-39	Test Radar	X	Mobile land-based
AN-TPQ-18	Test Radar	X	Fixed land-based
ATR-500C	Tracking Radar	X	Fixed land-based
FPQ-14	Test Radar	X	Fixed land-based
High Accuracy Instrumentation Radar (HAIR)	Range Radar	X	Fixed land-based
High Altitude Observatory (HALO)	Infrared/ Optical Sensor	X	Mobile air-based platform
Homing All-the-Way-Killer X-Band Doppler Radar	Test Radar		Fixed land-based
Midcourse Space Experiment (MSX)	Observatory sensors	X	Space-based
Millimeter Wave Radar	Test Radar	X	Fixed land-based
MK-74	Test Radar	X	Mobile land-based

Exhibit 2-16. Summary of Representative Test Sensors

Sensors	Type	Test Telemetry	Operating Environment
Recording Automatic Digital Optical Tracker	Optical sensor	X	Fixed land-based
Tracking and Discrimination Experiment Radar	Test Radar	X	Fixed land-based
W-Band Tornado Radar	Test Radar		Mobile land-based
Widebody Airborne Sensor Platform (WASP)	Tracking Radar	X	Mobile air-based platform

Targets

Because targets are test assets, they would not be deployed in the BMDS in the same way as weapons or sensors. Target missiles would be used to provide realistic threat challenges for testing new and evolving interceptor missile and sensor components that would comprise the BMDS. Target missiles would be used to validate the capabilities of the BMDS missile defense sensors and weapons. Target missiles typically mimic a possible threat, both in physical size and performance characteristics. A wide variety of target missiles would be used to support the development and test requirements of various BMDS elements, and validate their design and operational effectiveness. Targets would be used to test how well the BMDS can track the threat missile, communicate the threat to the appropriate ground command, and employ an interceptor to engage the threat. Targets can be launched from air, ground and sea platforms. The availability of multiple platform options allows the MDA to develop challenging and creative test scenarios, including salvos (i.e., simultaneous discharge of weapons), and also provides numerous viable options for test events to ensure safe testing.

Exhibit 2-17 shows the relative sizes and ranges of some typical test targets. Test targets are sometimes referred to by the names of their stages or motors.

Exhibit 2-17. Typical Test Targets

A typical target missile consists of one or more boosters and a target test object. Boosters are the rocket motors that sequentially activate to launch the missile. Target test objects are the parts of target missiles that are designed to represent threat warheads or reentry vehicles. (The term reentry vehicle is used in conjunction with threat missile.) A target test object typically separates from its booster(s); but some targets are non-separating.

Separating targets can be single-stage, meaning that they have one motor that initiates flight, or multiple-stage, with two or more motors that fire sequentially. Multiple stages allow a target missile to fly at higher velocities and altitudes, and for longer distances. Once the motor on a single-stage target has used all of its propellant, the spent stage may be jettisoned or released from the test object and falls back to Earth, often breaking up into small pieces before it reaches the surface of the designated test area. For targets with multiple stages, the first stage operates similar to a single stage target. However, after the first stage uses all of its propellant, that stage is jettisoned and the second stage or motor is ignited and the target continues on its path. This sequence of events is repeated until all of the stages have been used. Exhibit 2-18 lists the representative targets and boosters used by the MDA. There also are additional targets under development based on the Navy Trident-1 motors and alternative liquid fuel concepts.

Exhibit 2-18. Representative MDA Targets and Boosters

Targets	Aries
	Foreign Material Acquisition
	Hera
	Lance
	Liquid Propellant Target
	Long Range Air Launch Target
	Medium Range Target
	Minuteman II
	PATRIOT as a Target
	Peacekeeper Target Missile
	Short Range Air Launch Target
	Storm
	Strategic Target System
	Strypi
	Trident Target Missile, C-4
	Vandal
Boosters	Antares
	Black Brant
	Castor IVB
	Lynx
	Malemute
	M55, M56, M57
	Orbus
	SR-19
	Talos
	Terrier
	Trident C4 First Stage, Second Stage, Third Stage

The target test object would separate from the booster at a designated point in its flight. Test objects typically consist of steel or aluminum housing assembly, thermal sensors, guidance and control electronics, radio transmitters and receivers, a power supply (which may include lithium or nickel-cadmium batteries), and a Flight Termination System (FTS).

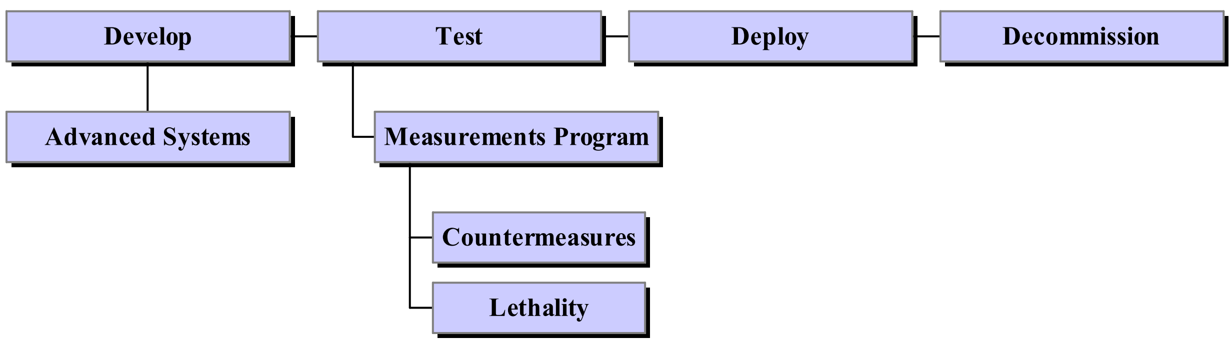
Target test objects may use countermeasures or decoys to imitate threat missiles as well as simulants to imitate the characteristics of the payload of a threat missile. Countermeasures are devices that accompany the target missile during its flight and attempt to confuse the sensors and C2 systems, making a successful intercept more difficult. Simulants are substances that mimic the significant characteristics of chemical, nuclear, biological or explosive payloads carried by threat missiles. Countermeasures

and simulants are also used to support the development and testing of the BMDS. They are programs within MDA's Measurements Program and are discussed further in Section 2.2.5.

2.2.5 MDA's Programs

The MDA implements several programs that support various aspects of the implementation of the BMDS, notably including the Advanced Systems program, the Measurements Program, and the International Program. As shown in Exhibit 2-19, the Advanced Systems program supports the development portion of the BMDS acquisition life cycle. The Measurements Program includes the Countermeasures and Corporate Lethality Programs, which support the test portion of the BMDS acquisition life cycle.

Exhibit 2-19. MDA Programs Supporting the BMDS Acquisition Life Cycle



Given the worldwide implications of ballistic missile defense, MDA also has an active International Program that includes the participation of several international partners in a variety of BMDS-related development and test activities.

2.2.5.1 Advanced Systems

The Advanced Systems program addresses research and technology improvements to enhance, supplement, or replace various building blocks or capabilities as the proposed BMDS evolves over time. Some technology improvements are currently proposed; others will evolve in the future (i.e., cannot be identified at present). Examples of current Advanced Systems projects include Project Hercules, the High Altitude Airship (HAA) and Multiple Kill Vehicles. Additional discussion of the MDA's Advanced Systems program can be found in Appendix F.

2.2.5.2 Measurements Program

To assess and characterize specific aspects of BMDS components' performance during testing, the MDA implements a Measurements Program. The program is designed to provide critical data and analyses that fulfill BMDS requirements identified and

prioritized by the Measurements Program Assessment Team. Measurements tests would be incorporated in individual component tests as well as integrated tests in laboratories, GTs of components, and during flight tests.

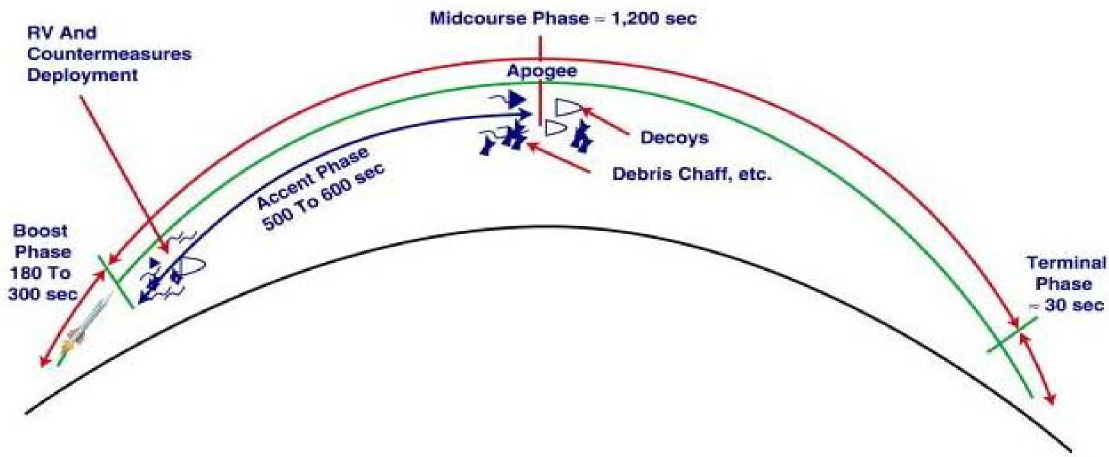
The Measurements Program would conduct critical measurements tests to collect data for all components to support system engineering assessments/performance verifications and ground effects analysis, and to characterize potential or actual countermeasures. At this time, “measurements” includes counter-countermeasures characterization, lethality, kill assessment, discrimination data, phenomenology measurements (the observation, description and explanation of the visible appearance of a test), and other critical measurements. The Measurements Program includes the Critical Measurements and Countermeasures Program (CM/CM), Countermeasure and Counter-countermeasure Program, and the Corporate Lethality Program. The CM/CM program is designed to address discrimination phenomenology, countermeasure performance, BMDS performance degradation, and potential mitigation options. The Countermeasure and Counter-countermeasure program attempts to characterize countermeasure signatures and to assess counter-countermeasure efficacy. Lethality, or the ability of the BMDS to prevent a ballistic missile threat from producing lethal effects, relies on kill assessment and other data gathered by BMDS component sensors and test sensors. Data are gathered through the Optical Data Analysis, Radar Data Analysis, and Radar Data Exploitation Programs.

Countermeasures

Countermeasures are designed to increase the probability that the reentry vehicle from a threat missile reaches its intended target. BMDS testing would include the use of robust countermeasures designed to mimic those that could be used on potential threat missiles. By testing the capabilities of U.S. interceptors against realistic targets including countermeasures the ability of the U.S. to respond to an enemy missile attack would be greatly enhanced. The specific signature and nature of the countermeasures that would be used as part of the BMDS testing activities are classified. Therefore, the discussion in this document on the potential impacts of countermeasures that would be used in BMDS testing is generic in nature.

There are two primary types of countermeasures, penetration aids or penaids and inherent countermeasures. Penaids are items that are added to the missile to increase the chance of the missile reaching its intended target. Penaids could be housed in the target reentry vehicle separation module. One penaid technique is for an offensive missile to carry, in addition to the actual target reentry vehicle, several decoy target reentry vehicles. These decoys, shown in Exhibit 2-20, when released, appear to be actual warheads. Inherent countermeasures are elements of normal operations of missiles that make it harder for interceptors to identify and destroy the target missile. This would include the separation

Exhibit 2-20. Deployment of Countermeasures during Flight Phases



of the reentry vehicle from the booster, which decreases the size of the portion of the missile to be tracked and destroyed by the interceptor.

There are various basic categories of countermeasures that could be used by MDA in characterization and in testing the BMDS. These include simulation, anti-simulation, traffic maskers/obscurants, aim point denial, and maneuver. Each uses different methods to add potential threat characteristics to targets used in the Measurements Program or in other BMDS testing.

Simulation countermeasures deploy various materials to confuse sensors and prevent them from correctly identifying the reentry vehicle. These countermeasures would primarily be fabricated from graphite, stainless steel, and tungsten. Anti-simulation countermeasures attempt to disguise the reentry vehicle by making the reentry vehicle look to the sensors like something other than a reentry vehicle. Traffic countermeasures deploy many items at once; this could include using multiple reentry vehicles or multiple countermeasures to confuse sensors. Maskers or obscurants are materials or objects that move in flight along with the reentry vehicle to confuse the sensors and prevent them from correctly identifying the reentry vehicle. Aim point denial is the ability to confuse the sensors from identifying the point on the reentry vehicle that should be hit to prevent the reentry vehicle from reaching its intended target. Maneuver countermeasures include the ability of reentry vehicles to change trajectory as they enter the atmosphere thus preventing the interceptor from predicting the path of the reentry vehicle. Other countermeasures are designed to increase the probability that the reentry vehicle reaches its intended target.

Lethality

Lethality is a measure of the ability of the BMDS to prevent a threat ballistic missile from producing lethal effects. Preventing a threat missile from completing its mission could entail the use of kinetic energy (hit-to-kill and blast fragmenting weapons) or directed energy (laser) to intercept and neutralize the target. Adequate lethality of the interceptor missile ensures the destruction of incoming enemy warheads to minimize potential threats. Lethality effects are described as either hard kills or soft kills. A hard kill occurs when damage done directly to the threat at the point of intercept results in the payload's immediate destruction. A soft kill occurs when damage done to the threat either causes the threat's destruction due to the effects of atmospheric drag/reentry on surviving payloads or prevents the payload from reaching its intended target. Lethality analyses begin at the moment of impact and continue through to interaction of the target pieces and any surviving payload contents with the Earth. The MDA is developing criteria to evaluate the lethality capability of BMDS technology against various threats. Potential enemy threats could include bulk High Explosive, High Explosive-laden submunitions, nuclear, biological, chemical, and bulk chemical payloads carried on tactical ballistic missiles.

Lethality studies include the monitoring and analysis of threat payload destruction and dispersion during intercepts of test threat targets. Although limited testing is done on actual lethal agents under controlled laboratory conditions, most of the testing relies on a number of payload simulants that, while chemically and biologically neutral, mimic the significant qualities, such as dispersion, weight, and viscosity of a toxic or hazardous substance for test purposes. Testing would require the use of existing simulants and may require the use of newly developed ones.

Because the countermeasures and lethality programs support BMDS testing, they will be considered along with other test assets (i.e., test bed, test sensors, and targets) in the analysis of impacts in Section 4.

2.2.5.3 International Programs

The MDA's mission is to develop and field an integrated BMDS capable of providing a layered defense for the U.S. homeland, deployed forces, allies and friends against ballistic missiles of all ranges in all phases of flight. To this end, the MDA supports a variety of international programs and invites international participation in its own programs. For example, the Arrow System Improvement Program is a joint undertaking with Israel, which will include technical cooperation to improve the performance of the AWS and a cooperative test and evaluation program to validate the improved performance.

2.3 BMDS Life Cycle Activities

This section describes the activities that occur during each phase of the acquisition life cycle (i.e., development, testing, deployment, and decommissioning) for BMDS components.

2.3.1 Development of BMDS Components

The MDA would develop the necessary components of the BMDS using an evolutionary spiral development process described in Section 2.1.3.2. The MDA would use existing infrastructure and components, when feasible, and would add emerging and new technologies as they become available. The components would be combined into specific configurations to achieve desired functional capabilities. Development activities would contribute to the evolution of the BMDS design as existing component configurations are altered or new configurations are created in response to evolving functional capabilities. During the development of new and modified components, environmental and occupational safety and health procedures would be developed. As outlined in Exhibit 1-3, development of BMDS components includes activities such as planning, budgeting, research and development, systems engineering, site preparation and construction, maintenance and sustainment, manufacture and initial testing of prototype test articles, and conduct of tabletop exercises.

2.3.1.1 Weapons

Weapons include interceptors and lasers as described in Section 2.2.1. Development of weapons components would build on existing infrastructure and capabilities of the BMDS elements. Research and development activities for weapons that could potentially have environmental consequences include research and development activities such as developing and testing propellant formulations for new rocket motors, developing or selecting casing materials, and developing and testing subscale rocket motors. System engineering tests such as hardware-in-the-loop tests would involve using an actual kill vehicle, intercept sensor unit, or directed energy component electrically connected to a computer system that simulates the functions of the other components of an interceptor. Repair, maintenance, and sustainment of weapons systems would include checks to ensure that system technology is still viable and cleaning, which may involve the use of solvents. Manufacturing and initial testing of prototype weapons technology may require static-fire testing of boosters or the firing of the HEL and may also involve the use of a sled (i.e., a carrier vehicle that is designed to move along a section of rail at speeds approaching missile flight velocities) to test boosters or to provide target opportunities. Tabletop exercises would allow developers to plan the interaction of a weapons system's internal technology, as well as its interaction with other components. These activities would occur at both contractor and government facilities and would include environmental and operational tests under simulated field conditions and computer simulations.

2.3.1.2 Sensors

The development of sensors would build on existing sensors and infrastructure including the current development efforts for radars such as X-band, S-band, L-band, C-band, and infrared, optical, and laser sensors as described in Section 2.2.2 and Appendix E. The types of activities involved in developing sensor components would include planning, budgeting, research and development, systems engineering, repair, maintenance, and sustainment, manufacture and initial testing of prototype test articles, and conduct of tabletop exercises. Research and development of mobile systems might include transportability demonstrations, possibly using aircraft and ground transport. All other development activities for sensors would be similar to those required for weapons. For example, systems engineering tests would include environmental and operational tests under simulated field conditions and computer simulations. These activities would occur at both contractor and government facilities and would include environmental and operational tests under simulated field conditions and computer simulations.

2.3.1.3 C2BMC

C2BMC includes the hardware and software and related infrastructure that connects and integrates the BMDS as described in Section 2.2.3. Development occurs in close conjunction with the weapons and sensors components described above and would utilize the existing assets and infrastructure when feasible. Development activities would include planning, budgeting, research and development, systems engineering, repair, maintenance, and sustainment, manufacture and initial testing of prototype test articles, and tabletop exercises.

For purposes of this PEIS, analysis of the environmental impacts associated with the installation, construction, or manufacture of C2BMC equipment and facilities will be considered, including computer terminals and displays (hardware) and the necessary computer programs (software) to provide BM and C2 functionality. C2BMC improvements may include simple software upgrades, updated computers, new facilities, buried communications cable, and, possibly, construction of new centers. Additionally, the analysis includes communications assets such as military and commercial satellite communications (COMSATCOM) terminals and antennas, radio communications terminals and antennas, and above- and below-ground communications cables (e.g., fiber optic and copper). A satellite communication system would provide satellite communications among C2BMC nodes. The satellite system would consist of satellite terminals, equipment buildings housing communications enclosures, backup power and dish antennae. The In-Flight Interceptor Communication System Data Terminal (IDT) is a part of the C2BMC and provides an in-flight communications link between nodes and interceptors. If a new satellite system or IDT system would be required, impacts would result from building construction and launch of the satellites. Fiber optic cable uses light pulses to transmit information along fiber optic lines. Where new fiber optic cable is

required, cable may be installed on either side of existing rights-of-way (e.g., normal roads or railroad tracks). Typically, fiber optic cable would be buried to a depth of approximately one meter (three feet) from the surface.

2.3.1.4 Support Assets

Support assets as described in Section 2.2.4 are the mobile and fixed auxiliary equipment, vehicles, and facilities that are needed to support and facilitate the operation and on-going evolution of BMDS components and testing of the system. Development of support assets including test assets for the BMDS would be closely coordinated with the development of the weapons, sensors, and C2BMC components. Planning for future support assets is critical to ensuring that they are acquired in time to meet the needs of upcoming BMDS components.

BMDS Test Bed

The BMDS Test Bed would encompass the infrastructure and environment where testing takes place. Development of the Test Bed would focus on planning for and acquiring infrastructure that enables realistic testing by permitting realistic geometries for sensor viewing and interceptor engagements. The proposed Test Bed includes test locations already being used, such as GT sites, or already developed, such as the GMD ETR in the Pacific Ocean. The MDA may also expand the Test Bed to include other areas in the Atlantic Ocean, Gulf of Mexico, outside the continental U.S., and ultimately a space-based test bed to support robust and realistic testing of BMDS components in those areas. The MDA would use existing sensors and launch facilities along the Atlantic and Gulf coasts to evaluate phenomenology and interoperability of sensors. Exhibit 2-21 lists the facilities in the Atlantic or Gulf of Mexico that are currently used for MDA activities or may be used in the future and could be eventually included in the BMDS Test Bed. Some facilities are independent, and others fall under the jurisdiction of a Range. Those installations that are under the jurisdiction of a Range are presented beneath that Range. The MDA would use launches from NASA and U.S. Air Force (USAF) facilities as targets of opportunity to reduce the number of MDA launches required.

Exhibit 2-21. Facilities Available in the Atlantic or Gulf of Mexico

Facility	Location
Gulf Test Range/Eglin AFB	Florida
Cape San Blas	Florida
Santa Rosa Island	Florida
Mobile Sea-Based Platform	Broad Ocean Area (BOA)
Eastern Test Range/Cape Canaveral Air Force Station	Florida
Mobile Sea-Based Platform	BOA
NASA Kennedy Space Center	Florida
Tyndall AFB	Florida
Space Port Florida (Florida Space Authority)	Florida
ISTEF – Merritt Island	Florida
Mobile Sea-Based Platform	
Cape Cod Air Station	Massachusetts
Hanscom AFB	Massachusetts
Lincoln Space Surveillance Complex	Massachusetts
Redstone Arsenal	Alabama
Naval Air Test Center Patuxent River	Maryland
Aberdeen Proving Ground	Maryland
Ocean City Municipal Airport	Maryland
NASA Wallops Flight Facility	Virginia
Newport News Municipal Airport	Virginia
GBI Development and Integration Laboratory	Alabama
Stennis Space Center	Mississippi

Test Sensors

Development of test sensors, as described in Section 2.3.1.2, would include activities similar to those that would occur in the development of the BMDS mission sensors and BMDS element sensors.

Targets

Preparing targets for flight test events would involve designing, prototyping, developing, procuring, certifying and qualifying them. Targets would be developed in response to the needs of BMDS and element testing requirements. To reduce costs, several targets would use retired components from other programs, including the U.S. Army Pershing II program, U.S. Navy Polaris program, Trident-1 (C-4), and U.S. Air Force Minuteman II program, as well as some Foreign Material Acquisitions. This practice would not only reduce the amount of raw material used but would also limit the amount of production

needed to develop realistic threat targets. These retired components may be used in their original configuration, or may undergo minor reconfiguration, depending on the specifications of the test. Every target system currently built meets unique test requirements; therefore, production of target systems is item-by-item and not in quantities. MDA is developing a family of targets to provide a standard target missile to support short-, medium-, and long-range test requirements.

Advanced target applications in progress include short- and long-range air-launched targets and liquid fuel boosters, as well as a multi-mode medium-range target. MDA is developing a family of targets that provides standard target missiles to support short, medium and long range test requirements. Mobile launch/basing platforms are being considered, along with the development and future procurement of advanced countermeasures and payloads.

Countermeasures

Development of countermeasures would involve detailed planning for test events, and identifying test objectives, appropriate countermeasures and counter-countermeasures, and acquiring any necessary materials.

Two types of defensive measures would be used to oppose countermeasures. The first would be improving sensor technology to more completely discriminate between the reentry vehicle and any deployed countermeasures. During the development of flight tests involving countermeasures, appropriate sensors would be selected and scheduled to participate in the test event. The second defensive measure would be improving interceptor technology to increase the chance that the interceptor can correctly identify and destroy the reentry vehicle. Development activities would include modeling and simulation as well as ground testing to characterize physical properties of countermeasures and predict behavior during flight tests.

Lethality

Assessing lethality involves the use of chemical or biological simulants that, while chemically and biologically neutral, mimic the significant qualities of a toxic or hazardous substance for test purposes. Development of simulants would involve research and planning, identification of neutral or inert substances with the required physical properties for specific tests, and in some cases manufacturing significant quantities of the simulant.

2.3.2 Testing of the BMDS

Testing is a critical aspect of the BMDS life cycle and under the spiral development process would occur simultaneously with the development and deployment periods of the life cycle acquisition process. Testing allows for the life cycle of all BMDS components to be closely correlated so that efforts in particular areas of the BMDS may be truncated or canceled if the results are unsatisfactory or where the development effort should be shifted to another integrated BMDS element to permit acceleration.

Testing will require several basic activities as outlined by component in Exhibit 1-3. Weapons, sensors and C2BMC components would be manufactured specifically for a test event, and appropriate site preparation and construction would be conducted at the test location. Infrastructure in the Test Bed would be constructed and prepared and components transported to the site, as necessary, and interceptors and targets would be assembled and fueled. Where necessary, sensors would be assembled before activation. The appropriate occupational safety and health procedures and appropriate training would be developed and followed for these activities.

Testing occurs at the component (Section 2.3.2.1), element (Section 2.3.2.2), and system (Section 2.3.2.3) levels. The goal of BMDS testing is to demonstrate integrated and effective functioning during increasingly complex and realistic engagement sequences. An engagement sequence is a unique combination of detect-control-engage functions performed by BMDS components (such as sensors, weapons and C2BMC) used to engage a threat ballistic missile. The C2, BM, and fire control functions enable the engagement sequence. Individual component and element tests are required to demonstrate the functionality of BMDS technology. Element tests evaluate the ability of component configurations to work together. These tests are the beginning of integrated BMDS tests. Some components may not be designed to be a part of an element (e.g., upgraded EWR). In those cases, the component would move from component level testing directly into System Integration Tests. See Section 2.3.2.3 for description and discussion of System Integration Tests. Integration testing is the activity that occurs above and beyond that which is required during the demonstration phase for each component or element. Integration system testing assesses the ability of BMDS components to work as a unit and to meet the required functional capabilities of the system.

2.3.2.1 Component Tests

The following describe the test activities that would be performed for each of the components in the proposed BMDS.

- **Weapons.** Weapons testing activities for interceptors would include the static firing of rocket boosters, sled tests, and isolated flight tests to confirm booster function (for single and multiple stages). For lasers, testing would demonstrate laser function and individual operation of laser-related components**.**

- **Sensors.** The primary objective of sensor component testing would be to evaluate performance in detecting and tracking surrogate threat ballistic missiles. Tests would utilize targets of opportunity, that is, launches supporting other research programs. Performance would be evaluated by comparing observed and predicted performance on target detectability, measurement accuracy, and tracking accuracy. In general, test objects representative of the reentry vehicles and countermeasures would be required to support both development and operational test and evaluation activities.

- **C2BMC.** The C2BMC must receive, fuse, and display tracking and status data from multiple components and coordinate firing/launches and intercepts. Testing would involve modeling and simulations to assess hardware and software capabilities and to demonstrate interoperability prior to participation in test events. C2BMC components would be tested in concert with their corresponding weapons and sensors components.

- **Support Assets.** Testing of support assets (including test assets) is discussed separately following the discussion of System Integration Tests. This includes the discussion of MDA Measurements Program countermeasures and simulants testing as part of test assets.

Testing of individual components has been largely addressed in existing NEPA analyses as listed in Appendix C, Related Documentation.

2.3.2.2 Element Tests

Element tests are required to evaluate the ability of component configurations to work together. Descriptions of element test activities and status by block are described in Appendix D, Descriptions of Proposed BMDS Elements. Testing of individual elements and support asset components have been largely addressed in existing NEPA analyses as described in Appendix C, Related Documentation.

2.3.2.3 System Integration Tests

The MDA is proposing to perform integration test activities on existing and planned components such as sensors, weapons, and C2BMC equipment. Integration testing of BMDS components provides system characterization, verification and assessment. Integration testing assesses the ability of BMDS components to work as a unit and to meet the required functional capabilities. Ongoing demonstration activities are required to assess a component’s continuing utility within the system. System Integration Tests

would be used to demonstrate BMDS performance. System Integration Tests rely on a foundation of individual component tests and culminate in SIFTs. This section describes typical flight test activities, the approach and descriptions of integration test events, and the contribution of the MDA's BMDS Measurements Programs to the assessment of technological capabilities.

Typical Flight Test

A typical weapons flight test would involve the use of a simulated airborne target, the use of a drone, or the launch of a target missile, the launch of an interceptor missile or the firing of a laser, and the intercept of the simulated threat missile target. Flight-testing also would provide measurements on the effectiveness against countermeasures and the lethality of the kill vehicle.

The MDA would deploy personnel and assets to the test locations to prepare for the flight mission (FM), conduct the flight test, and refurbish the test sites to pretest conditions, if applicable. Prior to a test event, the target launch site(s) would generally be occupied for approximately three months before a scheduled launch and about two weeks after a launch. A typical three-month launch cycle ramp-up would include 25 people during the first month, 25 to 75 people during the second month, and 100 to 150 people during the third month. Dual target launches would include approximately 25 people during the first month, 75 to 100 people during the second month, and 150 to 175 people during the third month. After a launch, approximately 50 personnel would immediately depart, and the remaining personnel would depart after launch site refurbishment.

The MDA would launch target missiles in a manner that represents relevant adversarial capability and provides the components with opportunities to practice their function in a realistic situation. The duration of a typical test flight would vary based on the component(s) that are involved and the flight phase where intercepts would occur. Flights with a planned intercept in the boost phase would last up to five minutes. Flights with intercepts in the midcourse phase would last from about five to 20 minutes. Flights with intercepts in the terminal phase would last up to approximately 20 to 30 minutes. Airspace surveillance procedures, which would be implemented to ensure range safety, would last as little as 45 minutes or longer if the test is delayed.

After launch, the target missile would slowly gain speed in the first few seconds of flight, and then rapidly accelerate out of sight and earshot. One minute into flight, a typical target missile would be at an altitude of approximately 16 to 19 kilometers (10 to 12 miles). The first stage would burn out, and in the case of a separating target, would fall within the predicted booster impact area. The second and third stages (if used) would perform in similar manners, and the target missile would climb out of the atmosphere and into space. The reentry vehicle or non-separating target would reenter the atmosphere and decelerate until it is intercepted or until the mission is completed.

To intercept the target missile, the tracking radar would acquire and track the target while the interceptor C2 system computes the best time to launch the interceptor missile. The interceptor missile would then be launched. Approximately one minute into flight, the interceptor would be at an altitude of about 50 kilometers (31 miles) and approximately 65 to 80 kilometers (40 to 50 miles) down range. (The altitude and distance down range will depend greatly on the trajectory and type of missile.) The first stage would burn out and fall within the predicted booster impact area. The second and third stages (if used) would ignite, and the interceptor would continue along its intended path. After burnout, the second and third stages would fall into their designated impact areas. After the final stage burnout, the interceptor, or deployed kill vehicle, would continue its flight until the target is intercepted. If the intercept were unsuccessful, the interceptor or kill vehicle would be destroyed by mission control or would be allowed to return to Earth. All booster stages and interceptors would be programmed to land in predetermined and verified clear areas. Intercept altitudes could vary from approximately 100 to more than 250 kilometers (62 to more than 150 miles). (The altitude and distance down range would depend greatly on the trajectory and type of missile.)

System Integration Testing Approach

The BMDS Test Program provides for a cohesive testing program of the interoperability of all Block architecture components and elements. System Integration Tests would involve interaction between and assessment of ground-, sea-, air- and, in some cases, space-based test assets. As the BMDS evolves, System Integration Test scenarios would become more complex and realistic to evaluate the integration of a higher number of working elements and components. More realistic scenarios would introduce an increasing number of targets. In addition, critical measurements programs may start as early as the components level and go up through integration system tests.

MDA's Responsible Test Organization provides the single point of responsibility, authority, and accountability for the BMD System Integration Testing. The Responsible Test Organization manages the test bed infrastructure and collaborates with the elements and components to develop system characterization and coordinate System Integration Tests. The Combined Test Force (CTF) is the execution arm of the Responsible Test Organization that develops long range and detailed plans, provisions, executes, acquires data from and analyzes the Campaigns.

The System Integration Test planning process is driven by goals that are laid out in guidance and technical objective documents. These objectives indicate the functional capabilities that need to be met by BMDS technologies. From the overview documents, a series of more detailed planning documents outline the details of test objectives, test requirements, and scenarios for System Integration Testing. These documents would be developed and revised regularly. Combinations of components that can meet functional capabilities would be identified. Dedicated component and element tests would be

synchronized to create a System Integration Test. Supporting components are identified to maximize the amount of data that can be gathered during a System Integration Test. System Integration Tests include modeling, simulation, and analysis, missile defense wargames, missile defense integration exercises (MDIEs), integrated GTs, and one or more SIFTs. System Integration Tests may also be performed for targets of opportunity. SIFTs are the culminating test event combining all prior test activities. These testing events evaluate component and integrated system performance and readiness.

A brief description of each type of System Integration Tests is provided in Exhibit 2-22.

Exhibit 2-22. Description of System Integration Tests

Test	Description
Modeling, Simulation, and Analysis	Modeling, simulation, and analysis are used during test planning, rehearsal, prediction of test outcomes, and post-flight assessment to verify and update models.
Integrated Missile Defense Wargames	Integrated missile defense wargames are table-top or computer simulations of military operations involving two or more opposing forces, using rules, data, and procedures designed to depict an actual or assumed real-life situation.
MDIEs	MDIEs are designed to characterize interoperability and how BMDS software components communicate prior to actual test flights.
Integrated GTs	GTs are tests used to collect data for BMDS components characterization and assessment and do not include booster function flight tests. GTs aim to reproduce the existing state of BMDS architecture, typically components scheduled for upcoming flight tests, to prepare for those flight tests and to assess component performance. For the purposes of this PEIS GTs do not include activities associated with components but rather have been focused on System Integration Testing.
SIFTs	SIFTs are conducted to verify the integration of select BMDS components. These tests generally include a target launch, sensors tracking the target, laser activation or an interceptor launch, and sensors to determine whether the target was destroyed. The number of sensors, weapons, and targets used in a SIFT can be adjusted to create the desired test scenario.

Modeling, Simulation, and Analysis

Modeling, simulation, and analysis are used to provide insight on test design and potential range constraints. Models are used prior to tests to rehearse and predict the test outcomes. In the post-flight phase, models are used to assess and analyze test results. Use of models allows the actual tests to be more successful, for example, by ensuring that a test does not violate a range constraint. Modeling also allows for "overlaying," a technique to predict and evaluate a component's response to a test exercise in which it did not participate. Analysis of post-flight data also allows the validation, verification and update of models.

Integrated Missile Defense Wargames

Integrated missile defense wargames are simulations, by whatever means, of military operations involving two or more opposing forces, using rules, data, and procedures designed to depict an actual or assumed real-life situation. They are designed to gain insight into how human decision-making affects the use of BMDS components. The MDA would use wargames to confirm the effectiveness of its CONOPS. The MDA could conduct multiple system-wide wargames per year. Prior to a wargame event, the MDA would determine the necessary data requirements. Integrated missile defense wargames are tabletop and computer simulation based and do not have a field component. Actual participants attend each wargame and the results allow insight into the information exchange between the BMDS elements and components, coordination during engagement, inventory expenditures, and improvement to CONOPS. For example, prior to a Campaign, an integrated missile defense wargame would be conducted with players and observers to examine BM schemes, shot doctrines, and other operations procedures.

Missile Defense Integration Exercises (MDIEs)

MDIEs are exercises designed to characterize how BMDS software components are communicating. The MDA has developed a Missile Defense System Exerciser to support interoperability testing. Its primary purpose is to characterize the interoperability among the BMDS elements, ensuring the ability to operate as a single system. Throughout the development of the BMDS, there are frequent updates to software, particularly the C2BMC software. The Missile Defense System Exerciser allows for tests of MDA software and hardware. An MDIE would be conducted specifically to support block software integration prior to SIFTs. The MDA plans to conduct multiple MDIEs per year.

Integrated GTs

GTs are tests used to collect data for BMDS characterization and assessment, and do not include component testing activities and System Integration Tests. For purposes of this PEIS, static test firings of rocket boosters, sled tests, or booster function flight tests are considered component level GTs. Component tests have largely been addressed in existing NEPA analyses as identified in Appendix D. Those analyses that were incorporated by reference are included in Appendix C. The analysis of GT activities considered in this PEIS focuses on system integration GTs, which would provide an understanding of the BMDS component integration and assessment, as well as how each component responds in different situations. Such tests provide data on risk reduction for system flight tests and for scenario exploration where flight-testing is either impractical or impossible. System integration GTs aim to reproduce the current state of BMDS architecture, typically components scheduled for upcoming flight tests, to prepare for those flight tests and to assess component performance. The GT tool must include weapon and sensor representations to do system performance testing and must be connected to a test bed as well as other deployed systems.

System Integration Flight Tests (SIFTs)

SIFTs measure BMDS component interoperability and assessment of BMDS functional capabilities in each developmental Block. SIFTs are the culminating test event that relies on testing activities such as integrated missile defense wargames and MDIE test events discussed above. They involve interaction between and assessment of ground-, sea-, air-, and, in some cases, space-based components. Each of the SIFTs incorporates dedicated component and element tests scheduled to occur at the same time. For example, testing of a specific interceptor would be synchronized to occur with the dedicated test of separate radar. The MDA plans to conduct up to two SIFTs per year.

Additional test components could be included in a SIFT to support data collection and overlays. For example, during a dedicated test of GMD’s ability to track and intercept a threat missile, the Aegis SPY-1 radar could be used as a forward sensor to track threat missile trajectory and relay it to the GMD interceptor. Any number of extra sensors could be tested during the SIFT to confirm other sensors’ tracking data. Overlaying is a technique to predict and evaluate a component’s response to a test exercise in which it did not participate. For example, the response of a PAC-3 interceptor to a threat that a THAAD interceptor actually engaged can be modeled to generate additional data and predictions.

Planned System Integration Tests

The MDA has planned a series of System Integration Tests to evaluate the status of the BMDS and its components. Activities conducted during a System Integration Test

include the planning of integration tests, production of components and support and test assets, and implementation of actual flight tests.

Targets and Countermeasures activities for Block 2004 would include the development of full-up target systems to support BMDS and element testing; development of payload suites for CM/CM flight tests and target risk reduction flights; and the maintenance, surveillance, refurbishment and routine testing of existing Government Furnished Equipment boosters.

The MDA plans to conduct a series of additional System Integration Tests to test the BMDS capabilities in Block 2004 and beyond. System Integration Tests represent independent flight tests that leverage from existing element or component tests. Future block testing would be planned and developed to meet the needs of the BMDS at the time of testing. Therefore, details of these integrated test events are only conceptual at this time. The general objectives and investment priorities for future Blocks include testing and validation efforts with a focus on integrated flight tests, with added realism and more stressing threat countermeasures. The BMDS layered defense is envisioned to be developing a strong boost phase intercept capability.

This PEIS examines the range of System Integration Test events as planned and described above. However, of the System Integration Test events, the GTs and SIFTs represent the most realistic testing scenarios. GTs involve the simultaneous activation of multiple sensors and C2BMC components, which would coordinate the control and transfer of information between weapons. A SIFT combines a range of test activities into a single test event that may occur over several days. SIFTs are designed to be increasingly complex integration tests over time. GTs and SIFTs are the only System Integration Tests with a field component and thus have the broadest range of potential environmental consequences. The example SIFT scenario described below is designed to capture the range of environmental effects that could occur from increasingly complex integrated testing of the BMDS. This example is meant to show a representative SIFT that could be conducted as part of the Proposed Action; it is not meant to be inclusive or exclusive of testing possibilities or launch trajectories.

Generic SIFT

A generic example of a SIFT would comprise initial selection of a launch and intercept of a single threat missile. In general, targets and interceptors would be launched from sites in the Test Bed. As a threat missile was launched, specific sensors would be tasked with acquiring and tracking the boosting threat missile and passing cueing information through the C2BMC to other sensor and weapon components. As the threat missile enters its midcourse phase, tracking responsibilities might be transferred to another component designed for that phase of flight. Additional cueing information would be passed again through the C2BMC to interceptor components. The threat reentry vehicle would be

identified and an interceptor launched. Intercepts would occur over designated land areas and BOAs. Once the threat had been intercepted, the component would perform a hit assessment and notify C2BMC of the results.

For example, a representative SIFT could include the GMD element engaging an ICBM long range target in the boost phase, with Aegis BMD acquiring and tracking the target from another location and sending the data to GMD. At the same time, Aegis BMD could engage a different target in the midcourse phase, with ABL acquiring and tracking the target during the boost phase. THAAD could engage another target in the terminal phase, coordinating with PAC-3 to identify the reentry vehicle. Additional components and elements could participate, by using the event as a target of opportunity (TOO) to validate their system performance.

Using information gathered during the SIFT; overlay scenarios would be constructed for other interceptor components. These scenarios would provide the ability to assess the capacities and limitations of each component in intercepting the threat without additional flight tests. Simulation overlays would also serve as a risk reduction in the integration of the components into the BMDS.

Future System Integration Tests

As discussed previously, System Integration Tests are designed to measure BMDS component interoperability and to assess BMDS functional capabilities. As the BMDS evolves to meet emerging threats, System Integration Tests must reflect the increasing number of integrated components. System Integration Tests become more complex as those components occupy more geographically diverse locations. Modeling, simulation, and analysis; MDIE; and integrated missile defense wargames are virtual tests (modeling and computational analyses) or software compatibility and communication tests that would be conducted within existing laboratory or test facilities. GTs involve the simultaneous activation of multiple sensors and C2BMC components, which would coordinate the control and transfer of information between weapons. However, SIFTs could involve the launch of targets and firing or launch of interceptors in addition to the participation of multiple sensors and C2BMC components.

SIFT scenarios attempt to capture more realistic intercept parameters. For purposes of this analysis, two representative scenarios that could be used during SIFTs under Alternatives 1 and 2 were considered. These two scenarios involve similar activities (launches of targets, use of multiple sensors, and use of land-, sea-, air-, and for Alternative 2 space-based weapons); however, they differ in number of target launches and number of weapons used. Both SIFT scenarios may be used to support the proposed BMDS and are analyzed in this PEIS.

SIFT Scenario 1 represents the simplest SIFT and would include the launch of a single target and use of a single weapon component to intercept the target. This scenario would use multiple sensors and C2BMC components. Under SIFT Scenario 1, the launch of the target and the activation of a laser or launch of an interceptor may occur within the same biome or may involve multiple biomes. As BMDS capabilities are proven, a second SIFT Scenario (*SIFT Scenario 2*) is envisioned that would build upon SIFT Scenario 1.

SIFT Scenario 2 would include the launch of up to two targets. For each target launch, more than one weapon component would be able to engage or "take a shot" at the target. Dual-target or interceptor launches would occur within seconds or minutes of each other. As with SIFT Scenario 1, numerous sensor components also would acquire the target and relay tracking data. Under this test scenario, the two targets may be launched from one biome and the weapons may be activated or launched from the same or different biomes.

SIFT scenarios are confined by geographic as well as range constraints that limit the number or types of launches that can occur at a specific location based on infrastructure and allowable debris impact zones. Each facility has either physical limits or regulatory limits on the number of simultaneous launches that it can execute. Test objectives also would limit the types of targets, countermeasures and simulants used.

The MDA would conduct future SIFTs in the existing or an expanded Test Bed. The current Test Bed is based around the Pacific Ocean. However, additional test facilities along the Atlantic Ocean and Gulf of Mexico as well as components located outside the continental U.S. may also be used.

2.3.2.4 Role of Test Assets in Integrated Testing

The MDA would use test assets to enhance the BMDS by simulating a threat missile in a realistic environment. Specific target missiles would be configured to meet the objectives of a SIFT scenario. Test assets would also support integration testing by providing infrastructure needed to assess the performance of components and systems, e.g., non-BMDS test sensors and telemetry may be used to acquire, record, and process data on targets and interceptors during testing.

Test Bed

The BMDS Test Bed would provide opportunities to use several target and interceptor missile trajectories that encompass a range of missile threats. Test Bed activities would help wargames prove out doctrine; operational concepts; tactics, techniques, procedures; and CONOPS in militarily relevant environments. Components of the Test Bed provide

IDC.[30] The IDC is comprised of the technical capabilities (hardware and software) of the BMDS available for operations on September 30, 2004. After the Combatant Commander has completed the requisite planning and the operators have been trained, qualified and certified to effectively employ the IDC equipment, along with the supporting integrated logistics and training systems, the components will constitute IDO.

Test Sensors

The primary objective of test sensor testing is to evaluate performance in detecting and tracking surrogate threat ballistic missiles. Tests would use targets of opportunity (TOO) as well as BMDS targets. Performance would be evaluated by comparing observed and predicted performance of the test sensor's ability to detect the target, accurately measure and track the target, and discriminate the reentry vehicle from countermeasures. In general, test objects representative of the threat ballistic missiles, reentry vehicles, and countermeasures would be required to support both development and operational test and evaluation activities for test sensors.

Targets

Target missiles are tested individually in risk reduction flights, to demonstrate their flight capabilities and ensure their safe operation. They are also used to test the capability of sensors. In interceptor tests, targets are used to test the coordination of the sensors, interceptors and C2BMC in completing a successful intercept. In some instances, the objective of the test event is to track and destroy the target with the defensive interceptor. Targets are also involved in flight tests as TOO. Tests using TOO rely on launches supporting other programs. In this instance, another program would participate in a passive role in a flight test, perhaps testing the ability of its sensors to track the target and communicate its properties to the appropriate ground control.

Flight-testing would be performed to verify performance and to test the interceptor's ability to engage and destroy target missiles under realistic conditions. Certain tests would involve only the acquisition of the target missile by the interceptor's seeker/sensor, while in other tests the target missile would be destroyed. In all cases, safety analyses would be conducted to ensure human health and safety are maintained and to avoid or minimize the possibility that any debris would cause harm to environmentally sensitive resources. Typically, several flight tests are conducted within a given test program.

Targets are transferred to their test locations by air, barge, and/or over-the-road truck for system assembly and checkout. Some missile components may be shipped to an airfield near the launch site and transferred to the launch site by local truck. Once target missiles

[30] IDC refers to the sensors, C2BMC, and weapons from Block 04 that are available for limited, militarily useful capability by September 2004. The IDC will include early warning and tracking sensors based on land, at sea, and in space, C2, and GBIs for midcourse and terminal intercepts.

reach the test range and are assembled, an appropriate Explosive Safety Quantity Distance (ESQD) would be established and maintained around facilities where ordnance would be stored or handled. Target missile launch preparation at ground launch sites may include the following activities: construction and/or modification of facilities and infrastructure to support launch preparation and flight test activities; fueling of liquid targets; transportation, handling, and storage of target missile system components and assemblies; assembly and maintenance of target missile and support equipment; and checkout and testing of target missile system components and assemblies.

Activities associated with ground, air, and sea launched targets differ based on the launch platform. In general, target missile operations at the test site may include missile assembly and checkout, maintenance, final inspections, testing and checkout for the reentry vehicle, and placement of the target on the launch pad.

Ground Launch Targets

Land launches of target missiles would be accomplished from a launch pad, launch stool, silo, or runway. Missiles would be assembled and checked out and erected on the launch stool or the pad or transferred to a launch silo before a scheduled test launch. Unmanned aerial vehicles or drones could also be used as targets. Drones can use a variety of engines including turbojet engines and gasoline powered combustion engines. Each missile storage or processing facility would have an ESQD established around it. Before a launch, a Launch Hazard Area (LHA) would be established. The LHA is the area that could be affected by missile debris should an explosion occur on or just above the launch area or in the event that the missile's flight must be terminated on the pad or just shortly after liftoff. This LHA is cleared of all non-mission essential personnel during launch operations to ensure personnel are not exposed to missile launch hazards.

Air Launch Targets

Air launches of target missiles may include target drones as described above for ground launch targets. However, for purposes of this analysis a typical Air Launch Target missile would use solid propellant boosters. The rocket motors for Air Launch Targets would be shipped from U.S. Government or contractor facilities by truck or air. Other components, such as the target/pallet assembly, would be shipped as applicable. When the target arrives at the test location, the motors would be assembled and the FTS installed and integrated with other components. The target reentry vehicle would be attached to the booster; then the booster, pallet and sled assembly, and support equipment would be loaded onto the aircraft.

Air Launch Targets would be launched from specifically configured U.S. Air Force cargo aircraft. Various target missile configurations could be used depending on the range needed for the particular test. The integrated target/pallet assembly would be loaded into

the aircraft and flown to a predetermined drop point. The target/pallet assembly would be pulled from the aircraft by parachute and dropped to a level between approximately 6,096 and 7,620 meters (20,000 and 25,000 feet) above mean sea level (MSL). The target would separate from the pallet and then descend via parachutes to approximately 4,100 meters (13,450 feet) above MSL. At this altitude, the parachutes would release the target, and motor ignition would occur during free-fall. After firing, the boosters would drop into predetermined areas in the ocean. The target would then follow its flight path to interception or to splash down within a designated ocean impact area. The target would be fitted with an FTS to terminate the flight if unsafe conditions develop.

Sea Launch Targets

Sea launches of target missiles would be conducted using specially configured missiles and any one of a number of sea-based platforms. The Sea Launch Target missile would consist of solid or liquid propellant boosters. The liquid propellant boosters can be either pre-fueled or non-pre-fueled. Target missiles and support equipment would be transported from U.S. Government storage depots or contractor facilities in accordance with Department of Transportation (DOT) regulations. They would be placed in secure storage until assembly and launch preparation. Applicable safety regulations would be followed in the transport and handling of hazardous materials. An appropriate ESQD would be established and maintained around facilities where ordnance is stored or handled.

Countermeasures

In Block 2004, the MDA would conduct activities that would contribute to the use of countermeasures in future Blocks. Dedicated flight tests of CM/CM, CM/CM-1 and CM/CM-2, would be conducted to support Block 2006/2008 system definition. During Block 2006 work would continue to improve existing countermeasure capabilities and provide new capabilities including development of payload suites for CM/CM flight tests and target risk reduction flights. The work completed during Block 2008 would represent a major step in the BMDS evolution. As target development matures, capability-based targets and payload suites (to include new and more complex countermeasures) would be developed, tested, and integrated into the BMDS testing program. The technical details for Block 2010 are less defined than near-term Block efforts however, it is expected that progression on the development and use of increasingly realistic countermeasures would be incorporated into the BMDS testing activities.

Lethality

Lethality studies include the monitoring and analysis of threat payload destruction and dispersion resulting from intercepts of test threat missiles. Although limited testing is done on actual lethal or live agents under controlled conditions (i.e., in a certified

laboratory environment), the majority of testing relies on a number of payload "simulants." Testing would require the use of existing simulants and may require the use of newly developed simulants.

The MDA divides lethality into four areas of interest. The first is target response, which analyzes the actual ballistic missile intercept of a threat. The second is the formation of the debris cloud containing both pieces of the target and any payload surviving the intercept. The third looks at the atmospheric conditions for transport and dispersion of the debris cloud. Last, the lethality program examines where and how much of the debris, especially the payload, impacts the Earth.

Lethality tests include investigating the impact of the intercept of various threat payloads at various altitudes and speeds. This involves using a mix of laboratory experiments, field tests, flight tests of opportunity, models, and hydrocode simulations and computational analysis. One critical objective of lethality testing is to calculate weapons of mass destruction intercept effects and consequences. Intercepts would occur in the boost phase of target flight or in the endo- or exoatmosphere. Therefore, the altitude and speed of intercepts may affect the effectiveness of an intercept and fate and transport of threat payloads. Because the nature of an incoming threat payload is unknown, lethality testing would assist in establishing a methodology to allow warhead typing based on impact response.

Simulant payloads would be incorporated into targets already scheduled to participate in BMDS element and system flight tests. This "piggy-back" method of data collection allows for the observation of tests of opportunity and the gathering of post-engagement lethality information. Analysis would be done to determine the damage done to submunitions (for both high explosive and chemical payloads) from interceptor missile impact. Submunitions are individual containers in the target designed to distribute a threat payload to a wider area. Multi-wavelength sensors would be used to track and characterize the resulting intercept debris cloud and its eventual impact on the ground.

Testing would also include the study of lethality enhancers, which aim to increase the kill radius of an interceptor missile. Examples of lethality enhancers could include additional explosives or tungsten pellets that explode out of the interceptor upon impact. In some cases, the additional explosives are included in the interceptor missile's FTS. Data collected from these tests would be used to continue to refine existing core lethality models. These studies are currently being conducted at federally funded research development centers, academic institutions, and DoD facilities in the U.S. and abroad. Simulated bulk chemicals can be dispersed upon impact with the interceptor and/or by using an explosive device. Using an explosive charge in the payload can enhance the dispersion of the chemicals, and thereby reduce the concentration of the simulant before it reaches ground level. In the event of a missed intercept, a termination device may be used to disperse the chemicals.

In Block 2004, the MDA would focus on resolving lethality questions and concerns for bulk chemical targets with simulants while transitioning to a greater focus on validating physical phenomena with full-scale flight-test data. This would include activities such as collecting data and analyzing various chemical agents and their simulants. Experiments would investigate the in-situ negation and breakup of simulants with a focus on boost and terminal phase intercepts. Lethality tests in future Blocks have yet to be determined but would involve similar tests based on prior block experiences and individual component and integrated testing plans.

2.3.3 Deployment of the BMDS

The U.S. would incrementally expand the functional capabilities of the BMDS by deploying components and elements as testing demonstrates that they are sufficiently capable of defending against threat ballistic missiles. Generally, a component would be deployed after it has been sufficiently developed and tested to demonstrate that it is capable of operating successfully within an integrated BMDS and the associated safety and health procedures are developed and deemed adequate.

The DoD is planning to use Missile Defense Test Bed assets to defend the U.S. when it has been determined that they provide a militarily useful defensive capability. However, the MDA could deploy individual developmental assets on an emergency basis, may field elements in limited numbers should it be determined that the prototype or test article had the potential to provide a militarily useful and sustainable capability, or the asset could be deployed if directed in support of national interests.[31] Components deployed on an emergency basis would function as partially integrated components of the BMDS until the emergency situation ends.

Deployment involves a series of actions to prepare the component or element to function in its defensive position and maintain a state of readiness to address missile threats. Deployment would involve fielding and sustainment activities as described below.

Development activities include acquiring components and planning for possible transfer to military services. As the missile defense acquisition agency, the MDA would be responsible for the purchase of developmental components and engaging the military services and Combatant Commands regarding their uses and sustainment. DoD decides that a military service will engage in component production with procurement funds. The MDA, through its development contractors, could build or assemble the component and the associated support assets needed for operation in the field. The MDA would engage the operating Combatant Command and the military service in transition planning to address roles and responsibilities regarding timing, resourcing, and other requirements.

[31]On December 17, 2002, President Bush directed the fielding of IDO capabilities by 2004, which would provide limited protection to defend the U.S. against ballistic missile attack. In October 2004, MDA achieved LDC when certain BMDS test components could also be placed on alert and used in defensive operations.

The military service and MDA would agree in writing on roles and responsibilities regarding the fielding of the components to include the preparation of the deployment site, transport of the component to the deployment site, installation and test in a field environment, and staffing the deployment sites. Preparing the deployment site includes facilities acquisition and related logistics functions that might be required to support the component in its fielded state. DoD direction to transfer the component to a service would establish the functions performed by MDA, the military service, and the Combatant Command(s). In the absence of an agreed to transition plan, or a DoD transfer decision, the MDA would operate and maintain the component.

Sustainment includes various maintenance and operating activities, including maintaining components in a ready state by conducting routine maintenance, repairing damaged or defective parts, testing the component's readiness, and resupplying the component with necessary materials. Component upgrades and service life extensions, as well as training operation personnel, also are sustainment activities.

Future deployment of BMDS components would occur at times and places where the deployed component would provide the most useful defensive capability to counter existing or emerging threats. This could include sites outside the continental U.S. The following subsections discuss potential deployment actions associated with each aspect of the deployment process (acquiring, fielding, transfer, and sustainment) that are considered in this PEIS.

2.3.3.1 Fielding BMDS Components

The MDA or a military service would obtain components for deployment by purchasing the components and their parts, and assembling the parts either on site or in an assembly facility, by transferring unused units originally planned for testing, or by ordering additional units from the manufacturer. Generally, the components would be manufactured by the same contractor and assembled in the same facilities where the units were manufactured and assembled for the testing program. However, the MDA or a military service would acquire the components from other sources if the existing contracts expire and a subsequent contract is awarded to another successful offeror. This PEIS assumes that components continue to be built by the existing development contractors at the same facilities because predictions of contract changes are speculative. All manufacturing would be conducted at facilities that are subject to Federal, state, and local environmental regulations. Construction of new facilities would be subject to all applicable requirements of NEPA, EO 12114, and other relevant Federal, state, and local environmental laws and regulations, as appropriate.

Fielding would include construction of facilities, transportation and installation of equipment, and training with the integrated components of the proposed BMDS.

Deployed components would be fielded at a number of locations to provide an integrated and evolutionary BMDS. Additional capabilities would be added to expand the BMDS as the technology develops. Components would be fielded at locations where they provide a layered defense against all phases of missile flight. Boost phase defense components would be fielded where they can operate in close proximity to potential threat missile launch sites. Midcourse defense components would be fielded at locations near potential missile flight paths. Terminal defense components would be fielded near theaters of operation, near major U.S. cities and other potential targets, and on allied territory.

The MDA or a military service would field components as directed by the DoD to provide a BMDS to counter a wider range of threats. Fielding of components requires several actions to move personnel and materials to the fielding site, prepare the site, place the component at the site, and to activate the component. Exhibit 2-23 summarizes typical fielding activities for the potential platforms.

Exhibit 2-23. Typical Fielding Activities

Platforms	Components	Typical Fielding Activities
Fixed and Mobile Land-based	Weapons, Sensors, C2BMC, Support Assets	▪ Site layout and clearing ▪ Facility construction, operation and maintenance ▪ Utility construction (electric, water, sewer, fiber optics, etc.) ▪ Material transport (truck, rail, air, ship) ▪ Waste management ▪ Human services (lodging, eating, work space)
Fixed and Mobile Sea-based	Weapons, Sensors, C2BMC, Support Assets	▪ Facility (e.g., dock, port) construction, operation and maintenance ▪ Utility construction (electric, water, sewer, fiber optics, etc.) ▪ Material transport (truck, rail, air, ship) ▪ Waste management ▪ Human services (lodging, eating, work space)
Mobile Air-based	Weapons, Sensors, C2BMC, Support Assets	▪ Airport and support facility construction, operation and maintenance (e.g., chemical plant) ▪ Utility construction (electric, water, sewer, fiber optics, etc.) ▪ Material transport (truck, rail, air, ship) ▪ Waste management

Exhibit 2-23. Typical Fielding Activities

Platforms	Components	Typical Fielding Activities
		▪ Human services (lodging, eating, work space)
Mobile Space-based	Weapons, Sensors, C2BMC, On Ground Support Assets	▪ Weapon or sensor construction ▪ Material transport (truck, rail, air, ship) ▪ Rocket launch ▪ Support facility construction, operation, and maintenance

In conjunction with combatant commanders, the MDA is planning to activate test assets (e.g., missiles, launchers, sensors, and C2 components) to provide continuous or near continuous defense of the U.S. The ongoing activities in support of the IDO at Vandenberg AFB and Fort Greely are illustrative of the site preparation activities that would be performed by the MDA when a component is fielded. The IDO fielding activities, and future fielding activities, would use existing facilities and infrastructure to the extent possible to minimize new construction. Site preparation at the two locations includes

- Construction of new or modified launch facilities and silos;
- Installation of sensors, fire control center, and C2BMC facilities;
- Development of missile assembly and launch preparation facilities;
- Development of facilities to store liquid propellants (fuel and oxidizers) and hazardous wastes;
- Installation of communication cables in existing conduits or new trenches, sensor hardstands, and antennae;
- Upgrade of electric power lines, installation of backup generators, and upgrades to water and sewer hookups as needed;
- Modification of existing or construction of new buildings to provide storage, maintenance, administrative space, security facilities, and housing;
- Upgrade of existing roadways and parking facilities, and
- Installation of security equipment.

The DoD transferred the PAC-3 program and realigned the MEADS program from MDA to the Department of the Army on February 5, 2003. As part of that transfer and realignment, MDA retained the responsibility for further research, development, test and evaluation, target development, future Block capability flight-testing, and software improvements to improve and maintain interoperability with C2BMC. This PEIS assumes that the MDA would retain similar responsibilities during future transfers to the military services.

2.3.3.2 Sustainment of BMDS Components

Sustainment of BMDS components includes operation, maintenance and repair, upgrades and service life extensions. MDA would operate deployed components until they are transferred to a service. Operation would include the consumption of fuel and power and generation of wastes. MDA and/or contractor personnel would conduct routine maintenance and repair on deployed components prior to transfer to a service. After transfer to a service, sustainment of components would be the responsibility of the appropriate service. Routine maintenance would primarily occur at the fielding location unless safety or environmental constraints necessitated a change in location.

2.3.4 Planning for Decommissioning of the BMDS

Decommissioning would involve the planning for the final demilitarization and disposal of the BMDS components and support assets no longer needed for the BMDS or its testing program. Decommissioning occurs when components reach the end of their effective service life, when technological advances render them obsolete, or when changes to the threat environment render them unnecessary at a location. Demilitarization is the act of destroying a system's offensive and defensive capabilities to prevent the equipment from being used for its intended military purpose. Demilitarization of the components would be performed in accordance with the DoD Directive 4160.21-M, *Defense Reutilization and Disposal*; DoD Directive 4160.21-M-1, *Defense Demilitarization Manual*; procedures developed by MDA or the responsible military service; and applicable Federal, state, and local regulations and procedures.

Disposal is the process of redistributing, transferring, donating, selling, abandoning, destroying, or any other disposition of the property. Disposal of components would involve establishing the availability of disposal facilities and then shipping hardware and materials to the disposal site. Disposal of materials would then conform to DoD directives, Joint Service Regulations, and comply with all applicable Federal and state laws.

Decommissioning processes will vary for weapons, sensors, C2BMC, and support assets and will be performed by the appropriate DoD agent. The following list describes the decommissioning activities that would be performed for each of the components in the proposed BMDS.

- **Weapons.** Decommisioning of weapon components would involve transferring the equipment to other uses or demilitarization in accordance with the appropriate requirements.

- **Sensors.** If sensor equipment is only needed for testing purposes and would not be used in the BMDS architecture, decommissioning would involve returning the

equipment to the responsible military service. If the equipment would be used in the BMDS architecture, decommissioning of sensors would include recycling/reuse or disposal or unused and residual materials, in accordance with the appropriate requirements. Additionally, assets can be converted to another MDA use, transferred to a military service, or sold. Space-based sensors would be decommissioned by being abandoned in orbit, parked in higher orbit, deorbited, retrieved, or reprogrammed for alternate uses.

- **C2BMC.** As technology advances and BMDS needs evolve, upgrades of C2BMC hardware and software would likely be necessary. C2BMC equipment that is replaced would be decommissioned in accordance with appropriate requirements.

- **Support Assets.** Decommissioning of equipment, infrastructure, and test assets would involve continued or adaptive use by the DoD or other government agencies, or performance of any necessary decontamination activities in the event the fixed asset will no longer be used, followed by sale. In the event of decommissioning, utilities could be left in place if the potential to use them for future DoD or other purposes existed. Mobile test or support assets would be refurbished and transferred to an alternate use, demilitarized, or dismantled and disposed. In terms of MDA BMDS Programs, aspects of particular MDA programs could be decommissioned by transferring them to another government agency, selling them, removing and using specific parts (i.e., sensors), or storing them at a government airfield. Each individual program also may have particular decommissioning activities associated with it.

Decommissioning could involve complete termination of operations and disposal of the system or its replacement with a new or upgraded system. Individual components would be removed from test ranges and test facilities at the conclusion of the testing activities. Testing facilities could also be decommissioned when they are no longer needed for the BMDS testing program.

Prior to decommissioning components, the MDA would evaluate the components for continued use by other U.S. Government agencies (e.g., U.S. Customs, U.S. Department of the Treasury) or as candidates for Foreign Military Sales. Various adaptive reuses would be analyzed and implemented if appropriate. If no adaptive reuses were identified, the units would be demilitarized and disposed as excess to the needs of the Government.

2.4 Alternatives

This PEIS considers two alternative approaches to providing the layered integrated BMDS program described in sections 2.1, 2.2, and 2.3. MDA analysis of the threat environment (potential launch locations, missile flight paths, and target locations) concludes that an effective missile defense should include weapons components based on at least the land, sea, and air. The addition of a space-based weapons platform would

provide another layer of missile defense capability. Providing only one or two weapons platforms would either leave areas unprotected or reduce the opportunities to engage threat missiles.

2.4.1 Alternative 1 – Implement Proposed BMDS with Land-, Sea-, Air-based Weapons Platforms

In Alternative 1, the MDA would develop, test, deploy, and plan to decommission land-, sea- and air-based platforms for BMDS weapons components and related architecture and assets. The BMDS envisioned in Alternative 1 would include space-based sensors, but would not include space-based weapons.

This section describes components and associated activities that would occur during each stage of the acquisition life cycle (development, testing, deployment, and decommissioning) under Alternative 1. Individual components would be developed and tested to determine the adequacy for deployment, that is, military utility and ability to function in an integrated BMDS. In addition, the BMDS C2BMC architecture would be designed and tested to meet the needs of an integrated system. Components deemed capable of integrated BMDS activities would be deployed and decommissioned as needed.

2.4.1.1 Alternative 1 - Development

Weapons subcomponents such as boosters, kill vehicles, and lasers would be derived from the existing and proposed elements. Development of the BMDS components as described in Section 2.3.1 for Alternative 1 would involve the following weapons components based on land, sea, and air operating environments

- Land – GMD GBI; THAAD; PAC-3; AWS; MEADS; KEI
- Sea – Aegis BMD; KEI
- Air – ABL

Development of BMDS sensors would build on existing sensors and infrastructure on land, sea, air and space operating environments. The development of C2BMC and support assets would be closely linked with the development of other components. The C2BMC is designed to mold components into a complementary and synergistic system-of-systems. Ongoing development of BMDS components is required to meet evolving functional capabilities. The main types of development activities include planning, budgeting, research and development, systems engineering, maintenance and sustainment, manufacture and initial testing of prototype test articles, and conduct of tabletop exercises.

New technologies are continuously being considered by the MDA's Advanced Systems program and by Systems Engineering Directorate within the MDA in concert with the National Team. The technologies and programs underway are discussed in Appendix F.

2.4.1.2 Alternative 1 - Testing

Testing activities, as discussed in Section 2.3.2, comprises the majority of activities under Alternative 1. Testing of the BMDS components and elements provides system characterization, verification, and assessment. Systems integrated tests rest on a foundation of component and element level tests, which were described in previous environmental documentation. This PEIS analyzes System Integration Tests including Modeling, Simulation and Analysis, integrated missile defense wargames, MDIEs, GTs and SIFTs. For the purposes of this analysis, all integrated tests with the exception of the SIFTs involve only ground-based components. The SIFTs could include a combination of any of the existing or planned land-, sea-, or air-based weapons components, and any land-, sea-, air- or space-based sensors and support assets. Integrated testing would determine the ability of the evolving C2BMC to integrate the BMDS components. The SIFTs will be discussed in terms of existing and reasonably foreseeable test scenarios. Existing SIFTs leverage currently scheduled element tests. Future SIFTs would be developed with increasing fidelity and complexity. SIFTs would involve the launch of at least one target missile to be negated by either an interceptor missile or a laser. Several sensor systems would acquire and track the target missile and interceptor missile (or ABL), as well as the actual intercept. For each planned test intercept, debris impact zones would be established. SIFTs could cross multiple environment types. Testing would occur within the confines of the U.S. and surrounding BOAs, as well as at some select locations abroad. As the proposed BMDS grows in capability, testing would expand to include more international sites.

2.4.1.3 Alternative 1 - Deployment

Under Alternative 1, the BMDS missile interceptors and directed energy missile defense system components, and related architecture and assets would be deployed on land-, sea- and air-based platforms. See Section 2.3.3 for a discussion of Deployment as part of the acquisition life cycle. Because the BMDS is envisioned to be an evolving system with interchangeable interoperable components, there is no final architecture defined for the system. Deployment would require fielding and sustainment of BMDS components in the U.S. and at strategic locations abroad. Components would be deployed as they are deemed capable of functioning within the BMDS. Fielding activities such as manufacturing, site preparation and construction and transport of components to deployment sites would be required. Sustainment activities include operation and maintenance of components, training, upgrades, and service life extensions where appropriate.

2.4.1.4 Alternative 1 - Planning for Decommissioning

Decommissioning would involve the planning for the final demilitarization and disposal of the BMDS components and support assets no longer needed for the BMDS or its testing program (see Section 2.3.4). Plans for decommissioning BMDS components and facilities would be incorporated into site development activities. Under Alternative 1, decommissioning of weapons would involve the removal and disposal of rocket propellant and dismantlement and disposal of residual materials such as the missile shell. Both testing as well as deployed components and facilities may be decommissioned. Thus, target missiles would undergo similar decommissioning processes.

Decommissioning of sensors would include the recycling/reuse and disposal of residual materials associated with the antennae, electronic, cooling and power units. Space-based sensors would be abandoned in orbit, parked in a higher orbit, deorbited, retrieved, or reprogrammed for alternate uses. C2BMC hardware and software would be upgraded or removed and disposed according to applicable requirements. Fixed facility support assets would be assigned new missions, returned to their owners, or transferred to new owners. Mobile support assets such as transportation vehicles, missile launchers and launch vehicles would be refurbished and transferred to an alternate use, or dismantled and disposed.

2.4.2 Alternative 2 – Implement Proposed BMDS with Land-, Sea-, Air- and Space-based Weapons Platforms

In Alternative 2, the MDA would develop, test, deploy and plan to decommission land-, sea-, air- and space-based platforms for weapons and related architecture and assets. Alternative 2 would be identical to Alternative 1, with the addition of space-based defensive weapons. A space-based test bed would be considered and evaluated to determine the feasibility of using kinetic energy to intercept threat missiles from space.

This section describes the space-based weapons components and associated acquisition life cycle activities under Alternative 2. Individual components would be tested to determine the adequacy for military utility and ability to function in an integrated BMDS. In addition, the BMDS C2BMC architecture would be designed and tested to meet the needs of an integrated system.

2.4.2.1 Alternative 2 - Development and Testing

MDA is developing an exoatmospheric kill vehicle (EKV), which, as described in Section 2.2.1, acts as the kinetic energy weapon on an interceptor. EKVs could be launched as hit-to-kill weapons from a space-based platform. Under Alternative 2, the KEI is a potential space-based defensive weapon to counter threat ballistic missiles during boost phase. The development of midcourse and terminal phase defensive

weapons may be included as well. The new interceptor would have effectiveness similar to earlier interceptors but would achieve it by decreasing the mass of the interceptor and increasing the speed at which the interceptor travels. This interceptor may use existing or new boosters; however, a new EKV would likely be designed for the interceptor. The EKV would be adaptable and could be launched from a space-based platform. Testing of a space-based weapons platform would involve ground-based testing including modeling and simulations of space-based technology, as well as multiple launches to emplace prototype technology in orbit. The prototype would then be tested in increasing realistic scenarios involving simulated and actual intercepts of targets. The Near-field Infrared Experiment (NFIRE) spacecraft could be launched on a Minotaur space launch vehicle from Wallops Flight Facility. The spacecraft bus would be shipped unfueled; however, the payload would be shipped fully fueled from the manufacturer. Spacecraft integration with the booster would also occur at Wallops Flight Facility.

2.4.2.2 Alternative 2 - Deployment

MDA would deploy EKVs and space-based launch platforms to deploy a space-based weapons component, currently envisioned as the KEI. The MDA would also obtain launch services to deploy the launch platform satellite and weapons components into their orbits. They could use Evolved Expendable Launch Vehicles launched from Vandenberg AFB and Cape Canaveral.

2.4.2.3 Alternative 2 - Planning for Decommissioning

A space-based weapons platform resembling a satellite would be decommissioned by being abandoned in orbit, parked in a higher orbit, deorbited, or retrieved. A weapons platform carrying a sensor system could have alternate uses including monitoring rocket launches and aircraft flights. MDA or the military services would make decisions on the disposition of the space-based weapons platforms based on the stability of the orbits, the costs and risks of deorbiting or retrieval, the remaining useful life of the equipment, and potential for alternate uses.

2.5 No Action Alternative

Under the No Action Alternative, the MDA would not test, develop, deploy, or plan for decommissioning activities for an integrated BMDS. Instead, the MDA would continue existing test and development of discrete missile defense systems as stand-alone defensive capabilities.

Under the No Action Alternative, individual components would continue to be tested to determine the adequacy of their stand-alone capabilities, but would not be subjected to integrated system-wide tests. In addition, the C2BMC architecture would be designed

around the needs of individual components and would not be designed or tested to meet the needs of an integrated system.

The approach and methods for deployment and decommissioning of components under the No Action Alternative would be the same as under the proposed action. However, deployment of individual components could occur earlier under the No Action Alternative because they would not undergo System Integration Testing. In addition, a greater number of units of the components may need to be deployed to provide a comparable number of opportunities to intercept threat missiles as provided by an integrated system.

Failure to deploy a fully integrated BMDS could result in the inability to respond to a ballistic missile attack on the U.S. or its deployed forces, allies and friends in a timely and successful fashion. This could result in the successful attack on one or more large population centers with chemical, biological, or nuclear weapons of mass destruction. The threat of such an attack could also jeopardize national security interests. Further, this alternative would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress.

2.6 Alternatives Considered But Not Carried Forward

2.6.1 Cancel Development of Ballistic Missile Defense Capabilities

As suggested to the MDA during the scoping process, one alternative would involve canceling the development of all ballistic missile defense capability development and testing. Such an alternative would rely upon diplomacy and military measures to deter missile threats against the U.S. However, this proposed alternative would eliminate the capability to defend the U.S., its deployed forces, allies, or assets from a ballistic missile attack should diplomacy or other deterrents fail. This alternative does not meet the purpose of or need for the proposed action as described in Sections 1.3 and 1.4, respectively; does not meet the direction of the President and the U.S. Congress; and therefore will not be analyzed further.

2.6.2 Single or Two-Platform BMDS

MDA has evaluated the threat environment (potential launch locations, missile flight paths, and target locations) and concluded that an effective missile defense should include components based on at least the land, sea, and air. Alternatives that provide only one or two platforms would reduce the capability of the BMDS to defend the U.S., its deployed forces, allies, or assets from a ballistic missile attack. This could result in the successful attack on one or more large population centers with chemical, biological, or nuclear weapons of mass destruction. The threat of such an attack could also jeopardize national security interests. Therefore, alternatives that provide a BMDS with only one or two platforms will not be carried forward for further analysis.

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3 AFFECTED ENVIRONMENT

Introduction

This Section discusses the biomes, ocean areas, and the atmosphere that comprise the Affected Environment in this PEIS, as well as the resource areas that could be impacted by the proposed action. This Section defines each resource area (Section 3.1) and discusses those resource areas within the context of a particular biome, ocean area or the atmosphere (Section 3.2).

The Affected Environment includes all land, air, water, and space environments where proposed activities are reasonably foreseeable. The Affected Environment considered in this PEIS includes specific locations in the U.S. and areas outside the U.S. As a result, applicable international treaties, foreign national laws and U.S. Federal, state, and local laws and regulations must be considered. The description of each resource area in Section 3.1 includes potentially relevant legal requirements and provides a roadmap of issues to consider for impacts assessment of a tiered document along with a determination of significance of the impacts. Appendix G contains additional information about laws and regulations that should be considered for subsequent impact analyses.

The Affected Environment for this PEIS examines global biomes[32] where development, testing, deployment, and planning for decommissioning activities for the proposed integrated BMDS may occur.

The biomes each cover a broad region, both geographically and ecologically. The distribution of global biomes is widely documented and accepted within the scientific community, and classification of biomes is based upon the characteristics of climate, geography, geology, vegetation, and wildlife.[33] Using biomes as affected environment designations captures the relevant differences between environments in a way that supports a useful analysis of impacts and allows future site-specific environmental documentation to tier from this PEIS. Note that there are no reasonably foreseeable BMDS activities occurring in Antarctica. For this reason, this continent does not appear on any of the biome maps in the PEIS.

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[32] Merriam-Webster defines biome as a major ecological community type (as tropical rain forest, grassland, or desert). (Merriam-Webster Online Dictionary, 2004)

[33] *Biogeography*, 2nd ed. James H. Brown and Mark V. Lomolino. Pages 110-111. Sinauer Associates, Inc. Publishers, 1998. (stating “[E]cologists and biogeographers have almost without exception classified terrestrial [ecosystems] on the basis of the structure or [natural features] of the vegetation.”)

The Affected Environment in this PEIS is divided into nine terrestrial biomes, the BOA, and the Atmosphere as identified below.

- Arctic Tundra
- Sub-Arctic Taiga
- Deciduous Forest
- Chaparral
- Grasslands
- Desert
- Tropical
- Savanna
- Mountain
- BOA
- Atmosphere

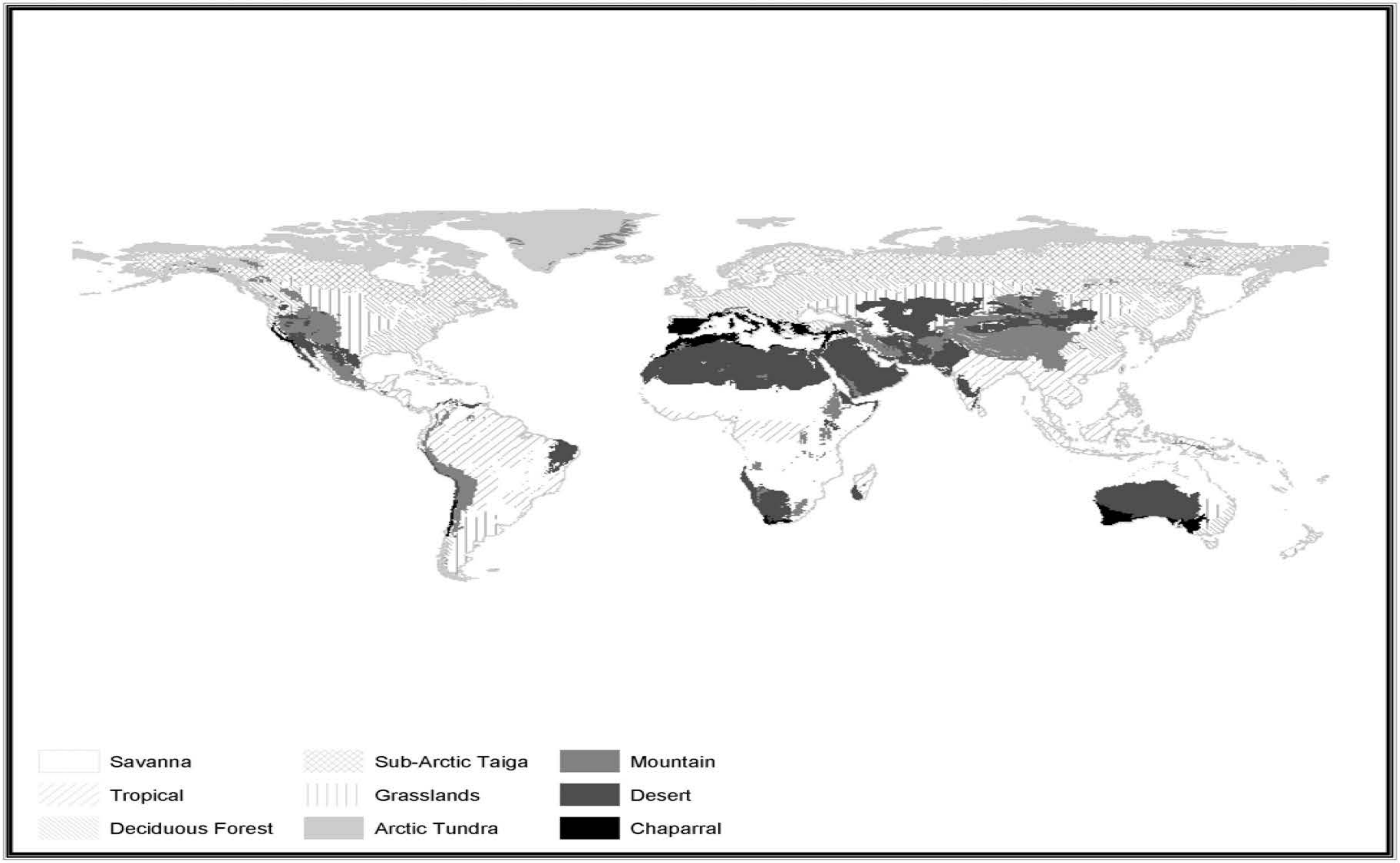
Exhibit 3-1 shows the global distribution of the various terrestrial biomes (not including the BOA and the Atmosphere). Biomes may be further subdivided based on geographic location; however, this PEIS considers nine overarching terrestrial biomes.

The characteristics (e.g., climate, geology, flora and fauna) that define a global biome are the same regardless of whether the biome area of concern is coastal or inland. However, unique features (e.g., wetlands, estuaries, wind currents, hurricanes) of coastal areas[34] may affect determination of environmental impacts. Therefore, the Affected Environment discusses these unique features within the biome descriptions. Describing coastal areas as part of the larger inland biomes minimizes repetition among the descriptions yet captures the important aspects of the coastal areas in a way suitable for impacts analysis.

Each biome description contains representative examples of past, current, or proposed locations used by the MDA within that biome. Therefore, an entity tiering from the PEIS would be able to map a particular site to its applicable biome. For example, WSMR in New Mexico is located within the Desert Biome. The description of the Desert Biome describes the particular characteristics of the biome that could affect the impacts of activities proposed at WSMR, or other locations in this biome.

[34] For the purposes of this PEIS, the coastal area includes the near shore, which is an indefinite zone extending seaward from the shoreline beyond the breaker zone, and is not coextensive with the area afforded protection under the Coastal Zone Management Act. This typically includes water depths of less than 20 meters (65 feet). The inland portion of the coastal area includes shoreline, tidal wetlands, coastal wetlands, and coastal estuaries.

Exhibit 3-1. Map of Global Biomes



Source: Modified From National Geographic, 2003b

- **Arctic Tundra Biome.** The Arctic Tundra Biome as described in Section 3.2.1 is located in areas above 60^{o} North latitude.[35] The areas of potential interest for the BMDS in the Arctic Tundra Biome include the arctic regions of North America and the arctic coastal regions that border the North Atlantic Ocean, North Pacific Ocean, and Arctic Ocean, including portions of Alaska, Canada, and Greenland (administered by Denmark).

- **Sub-Arctic Taiga Biome.** The Sub-Arctic Taiga Biome as described in Section 3.2.2 occurs between 50° to 60° North latitudes. The areas of interest in the Sub-Arctic Taiga Biome include the sub-arctic regions of North America and the sub-arctic coastal regions that border the North Pacific Ocean, including portions of Alaska.

- **Deciduous Forest Biome.** The Deciduous Forest Biome as described in Section 3.2.3 is located in the mid-latitude, which means that it is found between the Polar Regions and the tropics. The areas of interest in the Deciduous Forest Biome include the eastern and northwestern U.S. and portions of Europe.

- **Chaparral Biome.** The Chaparral Biome as described in Section 3.2.4 occurs on the west coastal regions of continents between 30° and 40° North and South of the equator. The Chaparral Biome areas of interest include a portion of the California Coast and the coastal region of the Mediterranean from the Alps to the Sahara Desert and from the Atlantic Ocean to the Caspian Sea.

- **Grasslands Biome.** The location of the Grasslands Biome as described in Section 3.2.5 is not limited to a particular latitude range. Instead, Grasslands occur in the middle of all continents, except Antarctica. The areas of interest in the Grasslands Biome include prairie regions of the Midwestern U.S.

- **Desert Biome.** The Desert Biome as described in Section 3.2.6 is located between 15° and 35° North and South of the equator. The area of interest in the Desert Biome includes the western arid environment of the southwestern U.S.

- **Mountain Biome.** The Mountain Biome as described in Section 3.2.7 occurs in areas with high elevations just below and above the snow line of a mountain. The area of interest in the Mountain Biome includes the Rocky Mountains in the western U.S. and the Alps in central Europe.

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[35] The latitudinal designations identify the general location for each biome; however, the biomes do not have rigid edges that begin and end at these latitudes. Therefore, there may be some overlap of biomes at or near these latitudinal designations.

- **Tropical Biome.** The Tropical Biome as described in Section 3.2.8 occurs between the Tropic of Cancer (23.5° North) and the Tropic of Capricorn (23.5° South). The area of interest in the Tropical Biome includes the Hawaiian Islands.

- **Savanna Biome.** The Savanna Biome as described in Section 3.2.9 occupies latitudes between 5º and 20º North and South of the equator. The area of interest in the Savanna Biome includes northern Australia.

- **Broad Ocean Area (BOA) Environment.** For the purposes of this PEIS, the BOA Environment as described in Section 3.2.10 includes the Pacific Ocean, the Atlantic Ocean, and the Indian Ocean.

- **Atmosphere Environment.** The Atmosphere Environment as described in Section 3.2.11 includes the atmosphere that envelops all areas of the Earth and consists of four principal layers: troposphere, stratosphere, mesosphere, and ionosphere (or thermosphere).

The description of the Affected Environment must be specific enough to allow meaningful assessment of potential impacts, yet broad enough to encompass all potential locations. The information in this Section and analysis in Section 4 do not purport to address site-specific issues. Additional analyses may be required to determine site-specific impacts for a proposed action.

The Affected Environment is discussed in terms of the following resource areas: air quality; airspace; biological resources; cultural resources; environmental justice; geology and soils; hazardous materials and hazardous waste; health and safety; land use; noise; socioeconomics; transportation; utilities; visual resources; and water resources. These areas represent the resources that the proposed BMDS may impact and were identified based on review of previous environmental documentation for the MDA, the DoD, and other agencies that conduct activities similar to those proposed for the BMDS (e.g., U.S. Air Force, NASA, FAA).

Definitions and descriptions are provided below for each resource area followed by a discussion of the issues that an impact assessment should address. Some resource areas are not analyzed in Section 4 of this PEIS, because they depend upon local factors and conditions and are too dependent on local information requirements to discuss meaningfully at a programmatic level. These resource areas include: cultural resources, environmental justice, land use, socioeconomics, utilities, and aesthetics (visual resources).

3.1 Resource Areas

3.1.1 Air Quality

Definition and Description

Air quality is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, the prevailing meteorological conditions, and the location of sensitive receptors relative to the source of the emission of air pollutants. Air pollutants of concern fall into four categories.

- **Criteria Air Pollutants**. These are a group of seven pollutants identified in the Clean Air Act for which the U.S. EPA is required to establish allowable concentrations in ambient air: sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (including the compounds that contribute to its formation - volatile organic compounds [VOCs] and nitrogen oxides [NO_X]), particulate matter (PM) with a diameter of less than ten microns (PM_{10}), particulate matter of with a diameter of 2.5 microns or less ($PM_{2.5}$), and lead.

- **Hazardous Air Pollutants (HAPs)**. These are a group of 188 chemicals identified in the 1990 Clean Air Act Amendments (40 U.S.C. 7412(b)). Exposure to these pollutants has been determined to cause or contribute to cancer, birth defects, genetic damage, and other adverse health effects. Examples of HAPs include benzene, asbestos, and carbon tetrachloride.

- **Mobile Source Air Toxics**. These are a group of 20 HAPs plus “diesel PM and diesel exhaust organic gases,” which are complex mixtures that contain numerous HAPs.

- **Regional Haze Pollutants**. The principle air pollutants that cause regional haze are SO_2, NO_X, VOC, PM_{10}, $PM_{2.5}$, and ammonia. The fraction of PM in the $PM_{2.5}$ size range is the most active component of PM in visibility degradation. SO_2, NO_X, VOC, and ammonia all undergo chemical transformations that result in the formation of sulfate, nitrate, and organic aerosols in the fine size range.

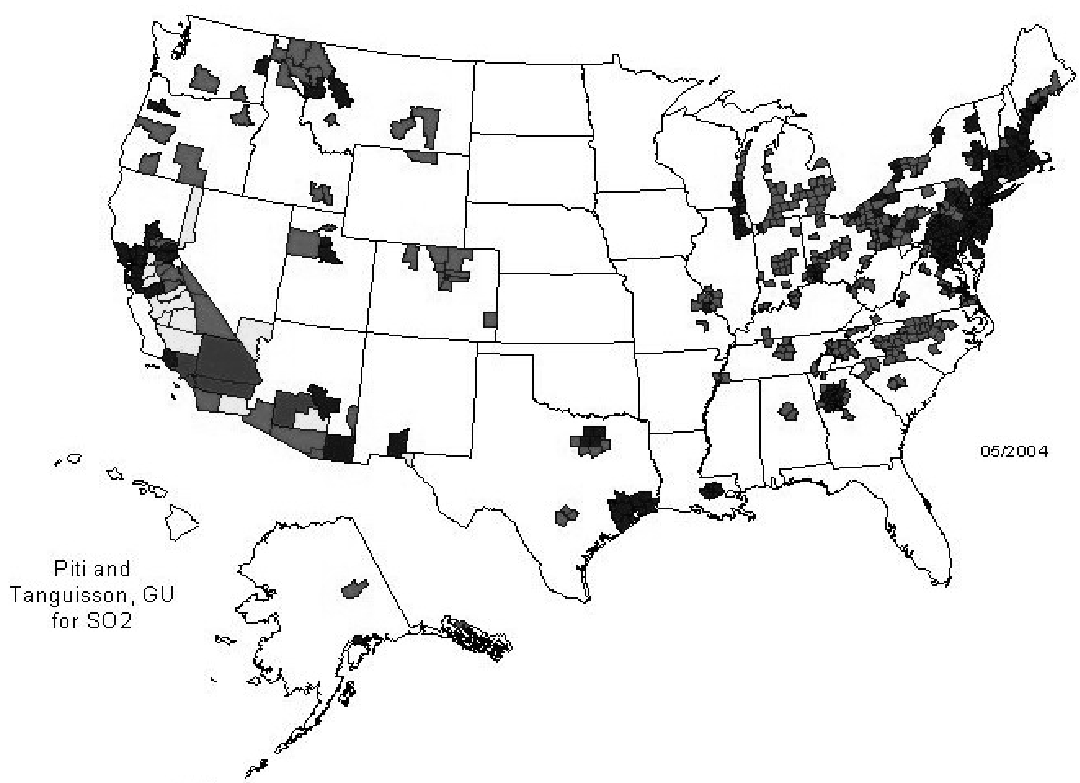
Sources of air pollutants include stationary sources (e.g., industrial facilities, refineries, power plants, launch pads), area sources (which are a collective representation of sources not specifically identified), mobile sources (e.g., motor vehicles, ships, aircraft, off-road engines, mobile platforms), and biogenic (natural) sources (e.g., forest fires, volcanoes).

The size and topography of the air basin, as well as the prevailing meteorological conditions determine how air pollutants are dispersed. Air currents carry secondary

pollution from one region to another, often increasing the background levels of air pollutants for the recipient regions. Such conditions are addressed in the Clean Air Act Section 184, which defines an Ozone Transport Region that includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Washington D.C. The emission standards are more protective in Ozone Transport Regions. An example of secondary pollution would be ozone (smog) created when NO_X and VOCs react in the presence of sunlight. The NO_X and VOCs could be released into the atmosphere a long distance from where the ozone ultimately degrades the air quality.

The Clean Air Act (42 U.S.C. 7401) requires the adoption of National Ambient Air Quality Standards (NAAQS) to protect the public health, safety, and welfare from known or anticipated effects of criteria air pollutants. According to EPA guidelines, an area with air quality better than the NAAQS is designated as being in attainment, while areas with worse air quality are classified as non-attainment areas. Pollutants in an area may be designated as unclassified when there are insufficient data for the EPA to identify attainment status. Current non-attainment areas in the U.S. are indicated in Exhibit 3-2.

Exhibit 3-2. Non-Attainment Areas for Criteria Pollutants January 2004



Note: Map is shaded by county to indicate the number of criteria pollutants for which the county is in non-attainment. However, the purpose of this exhibit is to generally illustrate the location of non-attainment areas in the U.S.

Source: EPA, 2004

The official list of non-attainment areas and a description of their boundaries can be found in the CFR at 40 CFR Part 81 and pertinent FR notices. EPA maintains an unofficial list on the Internet at http://www.epa.gov/oar/oaqps/greenbk/. As of February 2004, there were 68 non-attainment and 69 maintenance areas for ozone, 59 nonattainment and 24 maintenance areas for PM_{10}, 11 nonattainment and 65 maintenance areas for CO, 22 nonattainment and 30 maintenance areas for SO_2, and eight maintenance areas for lead.

For areas that are designated non-attainment, the Clean Air Act establishes levels and timetables for each region to achieve attainment of the NAAQS. States must prepare a State Implementation Plan (SIP), which documents how the region will reach its attainment levels by the required date. The SIP includes inventories of emissions within the area and establishes emissions budgets that are designed to bring the area into compliance with the NAAQS. In maintenance areas, the SIP documents how the state intends to maintain compliance with NAAQS.

Section 176(c) of the Clean Air Act prohibits Federal entities from taking actions in non-attainment or maintenance areas that do not "conform" to the SIP. The purpose of the conformity regulation is to ensure that Federal activities 1) do not interfere with the budgets in the SIPs; 2) do not cause or contribute to new violations of the NAAQS; and 3) do not impede the ability to attain or maintain the NAAQS. In November 1993, EPA promulgated two sets of regulations to implement CAA section 176(c):

- The Transportation Conformity Regulations, which establish the criteria and procedures for determining that transportation plans, programs, and projects funded under Title 23 U.S.C. or the Federal Transit Act conform to the SIP. The transportation conformity regulations are codified in 40 CFR 93, in Subpart A.

- The General Conformity Regulations, which ensure that other Federal actions also conform to the SIPs, and are applicable to all other Federal actions not covered under Transportation Conformity. The General Conformity regulations are codified in 40 CFR 93, Subpart B. All Federal actions are covered unless otherwise exempt (such as actions covered by transportation conformity, exempt actions listed in the rule, and cases where the action does not create emissions above the *de minimis* threshold levels specified by EPA regulations in 40 CFR 93.153(b)).

The proposed action is subject to the General Conformity Regulations, not Transportation Conformity Regulations. Under the General Conformity Regulations, MDA is required to determine whether the proposed action and alternatives would result in emissions within a non-attainment or maintenance area that would exceed established *de minimis* levels or would be regionally significant (i.e., exceed ten percent of the emission inventory). If so, MDA must make a General Conformity Determination in accordance

with EPA requirements. Exhibit 3-3 shows *de minimis* levels of pollutants for various non-attainment levels.

Exhibit 3-3. General Conformity *De Minimis* Levels

Criteria Pollutant	Area Designation	Pollutant	*De Minimis* Level, metric tons per year (tons per year)
Ozone	Extreme Non-attainment	NO_X or VOC	9 (10)
	Severe Non-attainment	NO_X or VOC	23 (25)
	Serious Non-attainment	NO_X or VOC	45 (50)
	Other Non-attainment with Transport	NO_X	91 (100)
	Other Non-attainment with Transport	VOC	45 (50)
	Other Non-attainment without Transport	NO_X or VOC	91 (100)
	Maintenance	NO_X	91 (100)
	Maintenance with Transport	VOC	45 (50)
	Maintenance without Transport	VOC	91 (100)
PM_{10}	Serious Non-attainment	PM_{10}	64 (70)
	Moderate Non-attainment	PM_{10}	91 (100)
	Maintenance	PM_{10}	91 (100)
CO	Non-attainment or Maintenance	CO	91 (100)
SO_2	Non-attainment or Maintenance	SO_2	91 (100)
NO_2	Non-attainment or Maintenance	NO_2	91 (100)
Lead	Non-attainment or Maintenance	Lead	23 (25)

Source: 40 CFR 93.153(b)

The Clean Air Act lists 188 HAPs, which are individual chemicals or elements that have been linked to observed human health effects such as increased risk of cancer, damage to the immune system, neurological problems, damage to reproductive systems (e.g., reduced fertility) and developmental systems, respiratory damage, and other health problems. Details on precisely how each HAP affects humans can be found in EPA's Integrated Risk Information System, a database available to the public.[36] The elemental

[36] EPA, 2003c

HAPs are primarily metals and families of metallic compounds (e.g., mercury compounds, arsenic compounds). The remaining HAPs are primarily organic compounds and selected inorganic gaseous compounds. Benzene, ethyl chloride, and pentachlorophenol are examples of organic HAPs. Hydrochloric acid and hydrogen fluoride are examples of inorganic HAPs.

The Clean Air Act regulations include a regional haze rule (64 FR 35714 [July 1, 1999]) that requires states to develop SIPs to address visibility at designated mandatory Class I areas, including 156 designated national parks, wilderness areas, and wildlife refuges. General features of the regional haze rule are that all states are required to prepare an emissions inventory of all haze related pollutants from all sources in all constituent counties. Most states will develop their regional haze SIPs in conjunction with their $PM_{2.5}$ SIPs over the next several years.

Another concern with respect to air quality is greenhouse gas emissions. The primary greenhouse gas emitted by anthropogenic or human-derived activities in the U.S. is CO_2, which represented approximately 84 percent of total greenhouse gas emissions in 2001. The largest source of CO_2, and of overall greenhouse gas emissions, is fossil fuel combustion, both from stationary (power plants, industry and manufacturing processes) and mobile sources (automobiles, trucks, construction equipment, lawn mowers). Electric power generation, from utilities and non-utilities combined, accounted for the largest source of U.S. greenhouse gas emissions in 2001, closely followed by transportation sources and industrial processes. On an annual basis, the overall consumption of fossil fuels in the U.S., and therefore emissions from the combustion of those fuels, generally fluctuates in response to changes in general economic conditions, energy prices, weather (temperature extremes during winters and summers), and the availability/acceptance of non-fossil fuel alternatives.

Although CO, NO_X, VOCs, and SO_2 do not have a direct global warming effect, they are regulated because of their role in influencing the formation and destruction of tropospheric (ground-level) and stratospheric (upper atmosphere) ozone. CO is produced when carbon-containing fuels are combusted incompletely. NO_X (i.e., nitrogen oxide [NO] and NO_2) originate predominantly from fossil fuel combustion, with the majority of emissions from mobile sources, but also from stationary sources. VOCs, which include hundreds of organic compounds that participate in atmospheric chemical reactions, are emitted primarily from transportation, industrial processes, and non-industrial consumption of organic solvents. In the U.S., SO_2 is primarily emitted from coal combustion for electric power generation and from the metals industry. (EPA, 2003b)

Impact Assessment

MDA activities that would contribute to air quality impacts include actions that emit criteria pollutants, HAPs, mobile source air toxics, or regional haze pollutants, as well as

compounds that would affect climate change. MDA actions that would result in the emission of such pollutants and compounds include missile launches, operation of internal combustion and jet engines, incineration, heating and cooling of facilities and components, use of fuel storage tanks, fueling activities, and construction. Best available control technologies are applied to new emissions sources and to sources that are modified to minimize the effects that MDA activities would have on air quality. Impacts on the regulated local and regional air quality from activities related to the proposed BMDS would result from construction and operation activities at specific locations, launch related activities, and other general activities. The emission of CO_2 and ozone-depleting substances associated with the proposed BMDS has the potential to result in climate change impacts.

Construction and Operations Activities

Emissions resulting from site preparation and construction activities as well as new or increased operations activities would include PM, CO, NO_X, sulfur oxides (SO_X), and VOC. The use of construction and supply equipment may increase all types of emissions. Emissions due to new or increased site operations activities would result from

- Increase in overland shipments related to new or increased operations;
- Use of new equipment and generators or increased use of existing equipment and generators;
- Relocation of support personnel and localized increase in commuter traffic;
- Use of new fuel storage facilities or the increased use of existing fuel storage facilities;
- Use of new facilities and associated infrastructure (boilers, solvent degreasing, painting, used oil, spills, and incineration) or the increased use of existing facilities and associated infrastructure; and
- Use of earth-moving equipment during construction.

Emissions should be determined using EPA emissions factors and compared against ambient air quality standards. The emissions associated with industrial operations would be compared against historically similar operations or by methods outlined in the toxics release inventory, as necessary.

Launch Emissions

Emissions resulting from launch related activities would include CO, NO_X, PM, SO_X, VOC, and hydrogen chloride (HCl). The analysis of launch emissions impacts can be considered in two categories, above and below 914 meters (3,000 feet). The 914-meter (3,000-foot) altitude is an appropriate threshold because the EPA uses this altitude for determining contributions of emissions to ambient local and regional air quality. EPA emissions factors should be used to determine emissions fractions for each emission

source for emissions above and below 914 meters (3,000 feet). Total emissions should be estimated by multiplying emissions fractions by the total amount of propellant used.

Determination of Significance

For actions that would occur in the U.S. within a non-attainment or maintenance area, the total annual emission of each criteria pollutant would be calculated and would be compared against EPA *de minimis* levels. Annual emissions values that exceed the *de minimis* level or ten percent of the total emission budget of the non-attainment or maintenance area, or state or local ambient air quality standards would be considered significant and would require a general conformity evaluation.

The risk associated with the emissions of HAPs on sensitive receptors within the U.S. would be evaluated. (EPA, 1999) Risk factors that exceed acceptable levels established by EPA would be considered significant. Emissions within the U.S. would also be compared against the requirements and standards included in SIPs to address visibility at Class 1 areas (156 designated national parks, wilderness areas, and wildlife refuges). Emissions that exceed the regional haze standard of an SIP would be considered a significant impact. Actions proposed to occur outside of the U.S. and its territories would be reviewed in accordance with applicable international or foreign ambient air quality standards. Emissions that would occur in locations that violate applicable international or foreign laws would be considered significant.

The effects of emissions that would occur above an altitude of 914 meters (3,000 feet) would be reviewed for potential contribution to ozone depletion (particularly in the upper troposphere/stratosphere), acid rain, and global warming. To determine the significance of impacts to air quality, emission levels would be compared with studies of other similar emissions, as well as U.S. or global emissions of ozone-depleting substances, acids and greenhouse gases (e.g., CO_2). Annual emissions greater than one percent of the global emissions, annual MDA program emissions that exceed the average level of emissions associated with the program over the preceding three years by more than ten percent or single events that exceed one percent of the global emissions would be considered significant.

3.1.2 Airspace

Definition and Description

Airspace refers to the space that lies above a nation and comes under its jurisdiction. Airspace is a finite resource that can be defined vertically and horizontally, as well as temporally. Time is an important factor in airspace management and air traffic control. The FAA has established various airspace designations to protect aircraft while operating near and between airports and while operating in airspace identified for defense-related

purposes. Flight rules and air traffic control procedures govern safe operations in each type of designated airspace. Military operations follow specific procedures to maximize flight safety for both military and civil aircraft.

The types of airspace are defined by the complexity or density of aircraft movements, the nature of operations conducted within the airspace, the level of safety required, and the national and public interest in the airspace. The classes of airspace are controlled, uncontrolled, special use, and other airspace, as defined in Exhibit 3-4.

Exhibit 3-4. Definitions of Airspace Categories

Category	Definition	Examples
Controlled Airspace	Airspace used by aircraft operating under Instrument Flight Rules (IFR) that require different levels of air traffic service	Altitudes above Flight Level (FL) 180 (5,500 meters [18,000 feet] above MSL) Airport Traffic Areas Airport Terminal Control Areas Jet Routes Victor Routes
Uncontrolled Airspace	Airspace primarily used by general aviation aircraft operating under Visual Flight Rules (VFR)	As high as 4,420 meters (14,500 feet) above MSL
Special Use Airspace	Airspace within which specific activities must be confined or access limitations are placed on non-participating aircraft	Restricted Areas Military Operating Areas (MOA)
Other Airspace	Airspace not included under controlled, uncontrolled, or special use categories	Military Training Routes

Controlled Airspace

Controlled Airspace covers airspace used by aircraft operating under IFR that require different levels of air traffic service. As shown in Exhibit 3-4, examples of controlled airspace include the altitudes above FL 180 (approximately 5,500 meters (18,000 feet) above MSL, some Airport Traffic Areas, and Airport Terminal Control Areas. General controlled airspace includes the established Federal airways system, which consists of the high altitude (Jet Routes) system flown above FL 180, and the low altitude structure (Victor Routes) flown below FL 180.

Controlled airspace has numerous designations from Class A to Class G depending upon the degree of airspace control required to maintain flight safety. Airspace in North America contains “North American Coastal Routes,” which are numerically coded routes

preplanned over existing airways and route systems to and from specific coastal fixes. North American Routes consist of

- **Common Route/Portion.** That segment of a North American Route between the inland navigation facility and the coastal fix.

- **Noncommon Route/Portion.** That segment of a North American Route between the inland navigation facility and a designated North American terminal.

- **Inland Navigation Facility.** A navigation aid on a North American Route at which the common route and/or the noncommon route begins or ends.

- **Coastal Fix.** A navigation aid or intersection where an aircraft transitions between the domestic route structure and the oceanic route structure.

During peak air travel times in the U.S., there are about 5,000 airplanes in the sky every hour. This translates to approximately 50,000 aircraft operating in U.S. skies each day. The U.S. airspace is divided into 21 zones (centers), and each zone is divided into sectors. Also within each zone are portions of airspace, about 81 kilometers (50 miles) in diameter, called Terminal Radar Approach Control airspaces. Multiple airports exist within each of these airspaces and each airport has its own airspace with an eight-kilometer (five-mile) radius.

Uncontrolled Airspace

Uncontrolled Airspace is primarily used by general aviation aircraft operating under VFR and generally refers to airspace not otherwise designated and operations below 365.8 meters (1,200 feet) above ground level. Uncontrolled airspace is not subject to the strict conditions of flight required by those aircraft using controlled airspace and can extend as high as 4,420 meters (14,500 feet) above MSL.

Special Use Airspace

Special Use Airspace is airspace within which specific activities must be confined or for other reasons, access limitations are imposed upon non-participating aircraft. The types of Special Use Airspace are

- **Alert Areas.** Alert areas are airspace in which a high volume of pilot training activities or unusual aerial activity takes place. The activities within alert areas are not considered hazardous to aircraft and are conducted in accordance with FAA regulations. Both participating and transiting aircraft are responsible for collision avoidance. (FAA, 2003)

- **Restricted Areas.** Restricted areas contain airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Activities within these areas are confined to permitted activities and limitations are imposed upon all other aircraft operations. Restricted areas generally are used to contain hazardous military activities. The term “hazardous” implies, but is not limited to, weapons deployment (these areas also are referred to as controlled firing areas and may be either live or inert), aircraft testing, and other activities that would be inconsistent or dangerous with the presence of non-participating aircraft.

- **MOAs.** MOAs include airspace designated for non-hazardous military activities and are established outside of controlled airspace below FL180. Typical activities that occur in MOAs include military pilot training, aerobatics, and combat tactics training. When MOAs are in use, non-participating aircraft flying under IFR clearances are directed by air traffic control to avoid the MOA. However, even when a MOA is in use, entry into the area by VFR aircraft is not prohibited, and flight by non-participating aircraft can occur on a see-and-avoid basis.

- **Prohibited Areas.** Prohibited areas include airspace where no aircraft may be operated without the permission of the using agency. This airspace is established for security and other national welfare reasons. (FAA, 2003)

- **Warning Areas.** Warning areas include airspace that may contain hazards to non-participating aircraft in international airspace. Warning areas are established beyond the 22.2-kilometer (12-nautical-mile) limit. Although the activities conducted within warning areas may be as hazardous as those in restricted areas, warning areas cannot be legally designated as restricted areas because they are over international waters. (FAA, 1996) By Presidential Proclamation No. 5928, December 27, 1988 (issued in 1989), the U.S. territorial limit was extended from 5.6 to 22.2 kilometers (three to 12 nautical miles). Special Federal Aviation Regulation 53 establishes certain regulatory warning areas within the new (5.6- to 22.2-kilometer [three to 12-nautical-mile]) territorial airspace to allow continuation of military activities while further regulatory requirements are determined.

Other Airspace

Other Airspace includes Military Training Routes. They are low altitude, high-speed routes established by the FAA as airspace for special use by the military services. Routes may be established as IFR Routes or VFR Routes. Military Training Routes are depicted on aeronautical charts and detailed descriptions are provided in the DoD Flight Information Publication AP/1B.

En route airways and jet routes are air corridors used by commercial and private aircraft. These corridors are generated based on the prevailing jet stream and their positions vary. The airways are identified by a “V” and a number designation and apply to altitudes up to 5.5 kilometers (18,000 feet). Jet routes are identified by a “J” and a number designation and apply to altitudes over 5.5 kilometers (18,000 feet). Coordination procedures used at locations where activities for the proposed BMDS may occur would prevent any potential impacts to aircraft in these routes.

Impact Assessment

Assessment of potential impacts on airspace would include a review and analysis of

- Projected volume and frequency of flights into airspace areas;
- Operating altitudes of vehicles, missiles, and targets;
- Lateral orientation of aircraft, missiles, and targets;
- Identification of airspaces that would be entered;
- Anticipated effect of the use of sensors on airspace availability;
- Effects of intercept or booster failure debris on airspace areas;
- Identification and description of the Region of Influence;
- Necessary approvals or agreements with controlling and using agencies for special use airspaces; and
- Comparison of airspace used by aircraft operating under IFR versus VFR.

Using this information, a map of the Region of Influence would be developed for the affected areas, as well as charts detailing the airspace areas and potential conflicts or approval hurdles. Specific activities may require letters of agreement to operate in certain airspace. Impacts on airspace due to activities associated with the proposed BMDS would be identified at the programmatic level and mitigated to the extent possible. Site-specific impacts on airspace would be addressed in site-specific documentation.

Determination of Significance

Actions that conflict with existing airspace use or designations where approvals or agreements with regulatory agencies cannot be obtained would be considered significant.

3.1.3 Biological Resources

Definition and Description

Native or naturalized vegetation (flora), wildlife (fauna), and the habitats they occupy are collectively referred to as biological resources. As part of the NEPA analysis, the potential impacts to all species potentially impacted by the proposed activity are

considered and evaluated. Special emphasis is placed on those species that are designated as sensitive. Plant and wildlife species may be designated as sensitive because of overall rarity, endangerment, unique habitat requirements, and restricted distribution. Generally, a combination of these factors leads to a sensitivity designation. Sensitive plant and wildlife species include those listed or proposed to be listed as threatened or endangered by the USFWS and National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries Service) under the Endangered Species Act, as well as those species listed by state wildlife resource agencies.

Federally or state listed species are afforded regulatory protection that involves a permitting process, including specific mitigation measures for any allowable (incidental) impacts to the species. Species proposed to be listed are treated similarly to listed species, but recommendations of the USFWS are advisory rather than mandatory in the case of proposed species. A federally listed endangered species is defined as any species, including subspecies that is in "in danger of extinction throughout all or a significant portion of its range." A federally listed threatened species is defined as any species "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Proposed threatened or endangered species are those species for which a proposed regulation has been published in the FR, but a final rule has not been issued. In addition, the USFWS may designate critical habitat for threatened or endangered species. Critical habitat is defined as specific areas, within the geographical areas occupied by the species at the time it is listed, which contain the physical or biological features essential to conservation of the species and may require special management considerations or protection. In 2003, Congress amended the Endangered Species Act to allow the Secretary of the Interior to exempt DoD sites from critical habitat designations if adequate natural resources management plans are in place at the sites.

Federal agencies that propose to conduct activities that may impact a listed species or a species proposed to be listed are required to consult with the USFWS under Section 7 of the Endangered Species Act. Additional consultation activities with USFWS and other agencies with natural resource management responsibilities may be required under other applicable laws and regulations. A listing of relevant laws, regulations, and EOs is provided in Appendix G.

Impact Assessment

The impact analysis should include existing information on plant and animal species and habitat types in the vicinity of proposed sites, with special emphasis on the presence of any species listed as threatened or endangered by Federal or state agencies. In the U.S., proposed activities must be coordinated with the appropriate state wildlife agency to determine if threatened and endangered species or critical habitat exists within the region

of influence. If the proponent of the proposed activity determines that threatened or endangered species or critical habitat may be affected by the proposed action, the proponent would initiate either informal consultation or formal consultation under Section 7 of the Endangered Species Act. The consultation process may require the proponent of the proposed activity to conduct a biological assessment, resulting in a biological opinion from the resource agency. This opinion would include mitigation actions required of the proponent to ensure that impacts to species and habitat would be minimized.

If the proponent of the proposed action determines that marine mammals may be affected by the proposed action, the proponent should consult with NOAA Fisheries Service, Department of Interior, U. S. Fish and Wildlife Service, as appropriate, to ensure compliance with the Marine Mammal Protection Act. The Marine Mammal Protection Act established a moratorium, with certain exceptions, on the taking of marine mammals in U.S. waters and by U.S. citizens on the high seas, and on the importing of marine mammals and marine mammal products into the U.S. If the proponent of the proposed action determines that coral reefs or endangered fish habitat may be affected by the proposed action, the proponent should work with NOAA Fisheries Service to ensure all requirements are met.

If the proponent of the proposed activity determines that migratory bird species may be adversely impacted, then the proponent should consult with the USFWS's Regional Migratory Bird Program, to ensure compliance with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. Under the Migratory Bird Treaty Act, the taking of migratory birds is not authorized without a permit. The project proponent should also consult with the USFWS to determine whether conservation measures may be implemented to minimize or avoid the take of migratory birds. MDA has included a technical appendix, Appendix N, considering the potential effects of radar on migratory birds.

MDA activities that could contribute to biological impacts include air emissions and noise from missiles, EMR or radio frequencies from sensors or support assets, habitat destruction through clearing activities, and construction and operations, as well as debris impacts.

Activities Resulting in Air Emissions

Air emissions from transportation vehicles, dust from clearing or construction, or launch emissions such as the ground cloud from lift-off could impact biological resources. The potential for launch emissions to impact local wildlife, vegetation, and specialized habitat, such as wetlands, should be considered.

Activities Resulting in Noise

Noise produced from missile launches and other activities related to the BMDS could affect biological resources. The potential for this noise to affect areas used by wildlife for migration, foraging, and breeding, should be considered.

Activities Resulting in EMR or Radio Frequencies

Radars and other equipment could emit EMR or radio frequencies, with the potential to impact biological resources. The analysis of EMR and radio frequency emissions should include the following metrics for review of Institute of Electrical and Electronics Engineers (IEEE) and American National Standards Institute (ANSI) standards for exposure to EM fields

- Peak and average power (modulation properties),
- Polarization of the EM field,
- Power density values for the beams over the range and azimuth of the sensor,
- Typical motion of the beams, and
- Size of the main and side beams.

Construction and Operation Activities

The impacts analysis should address construction activities and operations that could result in impacts to habitat including loss and restriction of habitat; light pollution; and leaks, spills, and other releases of contaminants. Noise impacts from operation of generators and construction equipment have the potential to impact species in the area. Other noise including sonic booms from launch and flight of missiles also should be analyzed for potential impacts on biological resources.

Debris Related Activities

Debris from booster failures or missile intercepts could impact biological resources. Debris would fall in pre-established impact zones on land or in water. The expected casualty to humans from debris produced during launches would be less than or equal to 30×10^{-6}. Debris recovery efforts, if required, would only occur on land and could result in impacts to biological resources from transportation activities. Such disturbances could include noise, emissions, fire caused by debris or unspent fuel, chemical payloads (such as tributyl phosphate), and surface disturbance impacts.

Determination of Significance

Actions that negatively affect a species or its habitat (critical habitat or essential fish habitat) protected under Federal or state law or an international treaty (e.g., Endangered

Species Act, Marine Mammal Protection Act, Magnuson-Stevens Fishery Conservation and Management Act), as well as other resources provided protection under Federal or state regulations or orders (e.g., Sikes Act, Migratory Bird Treaty Act, EO 13112 Invasive Species), where appropriate consultation or considerations have not been completed, documented, and implemented would be considered significant. In addition, it may be appropriate to consider multiple species habitat conservation planning efforts occurring in areas proximate to proposed BMDS activities.

3.1.4 Cultural Resources

Definition and Description

Cultural resources include prehistoric and historic artifacts, archaeological sites (including underwater sites), historic buildings and structures, and traditional resources (such as Native American and Native Hawaiian religious sites). Paleontological resources are fossil remains of prehistoric plant and animal species and may include bones, shells, leaves, and pollen.

Cultural resources of particular concern include properties listed or eligible for inclusion in the National Register of Historic Places (National Register). Only those cultural resources determined to be potentially significant under 36 CFR 60.4 are subject to protection from adverse impacts resulting from an undertaking. To be considered significant, cultural resources must meet one or more of the criteria established by the National Park Service that would make that resource eligible for inclusion in the National Register. The term “eligible for inclusion in the National Register” includes all properties that meet the National Register listing criteria which are specified in Department of Interior regulations at 36 CFR 60.4. Therefore, sites not yet evaluated may be considered potentially eligible for the National Register and, as such, are afforded the same regulatory consideration as nominated properties. Whether prehistoric, historic, or traditional, significant cultural resources are referred to as historic properties.

Impact Assessment

Because they possess unique qualities and characteristics, cultural and historic resources should be identified and analyzed in site-specific environmental documentation. The analysis should include consideration of the contemporary use of historic properties owned by the Federal government and intergovernmental cooperation and partnerships for the preservation and use of historic properties as required by EO 13287, Preserving America. MDA activities that could impact cultural resources primarily include construction, operation, and debris impacts.

Construction and Operation Activities

The analysis should address construction and operation activities that could result in ground disturbances, vibrations, significant air emissions, or leaks, spills, and other accidental releases of contaminants. The proponent should identify the region of influence for the activities and contact the appropriate State Historic Preservation Officer to determine whether there are any known listed or eligible sites in the vicinity and to determine whether mitigation measures are required, such as: site-specific cultural and historic surveys, records searches of the sacred lands of the Native American Heritage Commission to determine the presence of Native American cultural resources in the region of influence, contacting Native American individuals and organizations for additional information, and using a qualified archaeologist to monitor site-specific ground-disturbing activities during construction. If appropriate, construction-related personnel would be informed of the sensitivity of cultural resources and the penalties that could be incurred if sites are damaged or destroyed. If during construction, cultural items are discovered, activities should cease in the immediate area and the corresponding State or Tribal Historic Preservation Officer would be notified. Subsequent actions should follow the guidance provided.

Debris Related Activities

Debris resulting from booster failures and missile intercepts could impact cultural resources. However, prior to establishing debris impact zones, archeological, cultural and historic surveys would be conducted to determine the presence of such resources. Debris recovery efforts, if required, would only occur on land, but should not impact cultural resources outside the impact zone. Efforts would be made to mitigate any impacts of transportation, noise, emissions and surface disturbance during recovery efforts.

Determination of Significance

Actions that would destroy or alter the character of a historic property on, or eligible for inclusion on the National Register, or actions that would adversely affect a Native American or traditional cultural property, where appropriate consultation in accordance with the National Historic Preservation Act has not been completed, would be considered significant. Such consultations and mitigation measures must be approved by the appropriate State Historic Preservation Officer, Tribal Historic Preservation Officer, or the ACHP.

3.1.5 Environmental Justice

Definition and Description

Environmental Justice (EO 12898) is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the exclusion of Federal, state, local, and tribal programs and policies. Meaningful involvement means that potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that would affect their environment or health; the public's contribution can influence the regulatory agency's decision; the concerns of all participants involved would be considered in the decision-making process; and the decision-makers would seek out and facilitate the involvement of those potentially affected.

Environmental Justice concerns include consideration of the race, ethnicity, and the poverty status of populations near the site of a proposed action. The CEQ defined "minority" to consist of the following groups: Black/African American, Asian, Native Hawaiian or Other Pacific Islander, American Indian or Alaska Native, and Hispanic populations (regardless of race). The Interagency Federal Working Group on Environmental Justice guidance states that a "minority population" may be present in an area if the minority population percentage in the area of interest is "meaningfully greater" than the minority population in the general population. The CEQ defined "low-income populations" as those identified with the annual statistical poverty thresholds from the Bureau of the Census. The accepted rationale in determining what constitutes a low-income population is similar to minority populations, in that when the low-income population percentage within the area of interest is "meaningfully greater" than the low-income population in the general population, the community in question is considered to be low-income.

Impact Assessment

Although each community is unique, there are several determination procedures that are common to most environmental justice assessments. One must first identify whether the geographic area under consideration qualifies as low-income or minority-based. To identify minorities or low-income populations, the Environmental Index methodology in EPA Region 6, Office of Planning and Coordination, dated 1996 would be used. Based on that guidance, environmental justice populations can be defined as meeting either of the following criteria

- Over one-half of the residents are minorities; or
- Over one-half of the households are low income.

An analysis of the most recent census data for the area provides this information. The U.S. Census Bureau maintains census data for racial classifications and income levels. The five racial classifications for which data are maintained are white, black, Hispanic, American Indian/Eskimo/Aleut, and Asian/Pacific Islander. Low-income data relates to those households that fall below the mean poverty level. Using these data, the percentages of minority and low-income populations may be determined for a particular geographic area.

After determining whether a minority or low-income population exists in the area, a determination must be made as to whether the proposed action would have a disproportionately high or adverse effect on those populations. The analysis involves first determining whether there are significant and adverse impacts and second whether those impacts disproportionately affect the minority or low-income population in the area. Where environmental justice concerns are found, the EPA recommends increased public involvement, perhaps as early as project scoping. Public participation and access to information are emphasized in EO 12898 and the Presidential Memorandum. The Presidential Memorandum instructs agencies to provide opportunities for community input throughout the NEPA process, including identifying potential effects and mitigation measures in consultation with the community and improving access to meetings, documents, and notices.

Environmental justice analyses require information about local communities, and therefore will be analyzed in site-specific environmental documentation.

Determination of Significance

Adverse environmental impacts that disproportionately affect minority or low-income populations would be considered significant.

3.1.6 Geology and Soils

Definition and Description

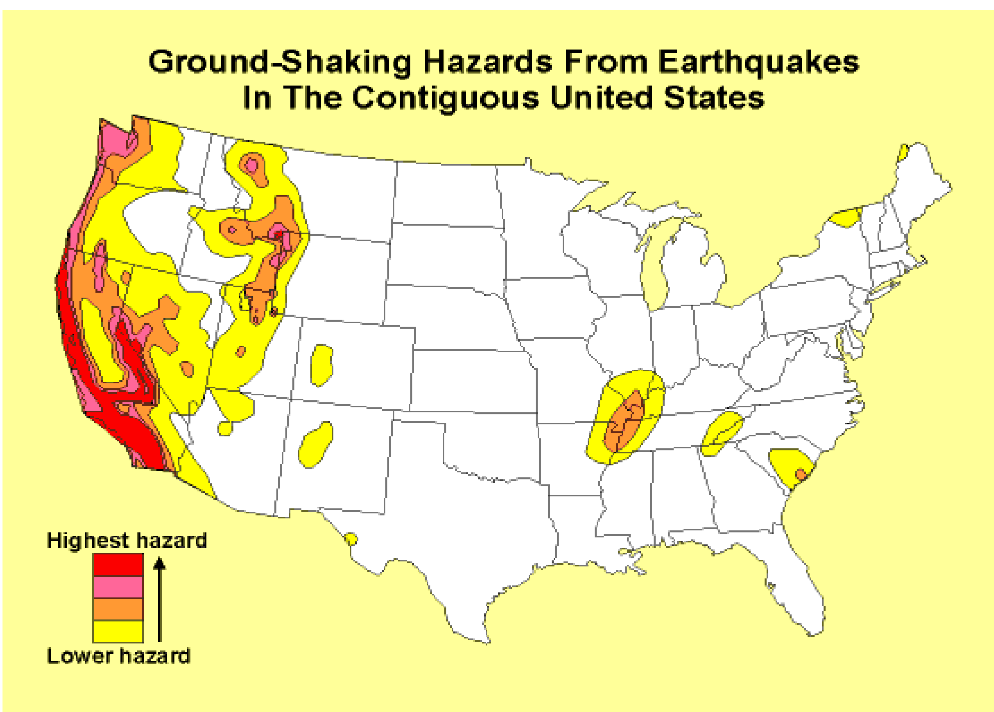
Geology and soils are those earth resources that may be described in terms of landforms, geology, and soil conditions. The makeup of geology and soils, including freshwater and marine sediments, could influence erosion, depletion of mineral or energy resources, seismic risk or landslide, structural design, and soil and ground water contamination resulting from proposed construction and operational activities.

Geology is the study of the composition and configuration of the Earth's surface and subsurface features. The general shape and arrangement of a land surface, including its height and the position of its natural and man-made features, is referred to as topography. The topography of the land surface can influence erosion rates and the general direction of surface water and ground water flow. Ground water is stored and transmitted underground in aquifers that supply lakes and rivers and is often used for human purposes, such as drinking water and irrigation for crops.

Geologic conditions also influence the potential for naturally occurring or human-induced hazards, which could pose risk to life or property. Such hazards could include phenomena such as landslides, flooding, ground subsidence, volcanic activity, faulting, earthquakes, and tsunamis (tidal waves). The potential for geologic hazards is described relative to each biome type's geologic setting. Exhibit 3-5 shows the geographic distribution for earthquakes in the continental U.S. Exhibit 3-6 shows landslide areas in the continental U.S.

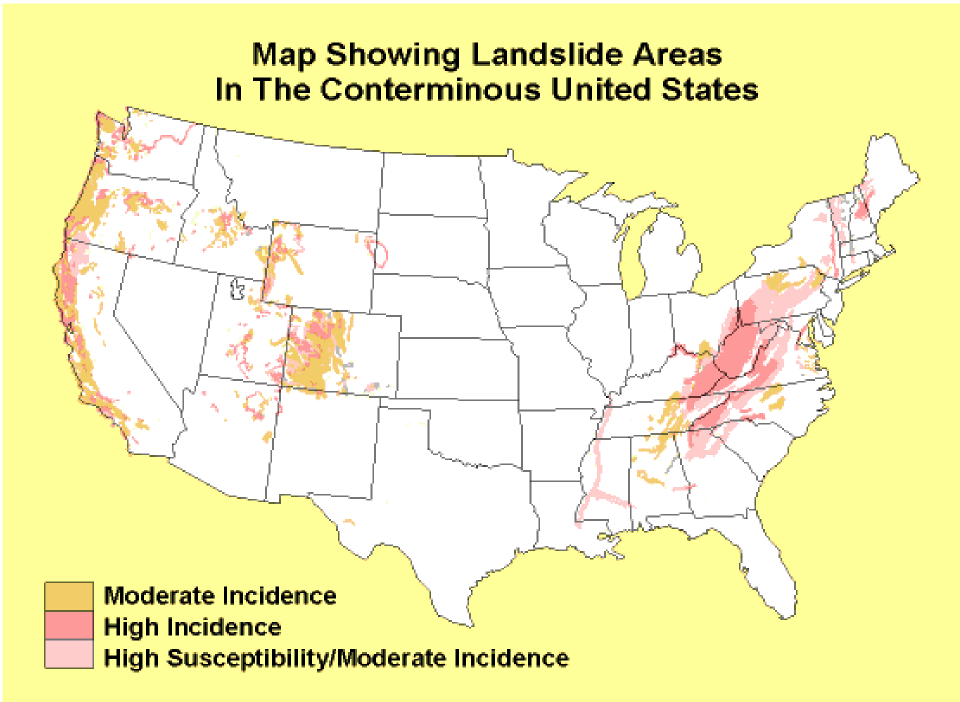
Soils and sediments are the unconsolidated materials overlying bedrock or other parent material. Soils and sediments typically are described in terms of their composition, slope, and physical characteristics. Differences among soil and sediment types in terms of their structure, elasticity, strength, shrink-swell potential, and erosion potential affect their

Exhibit 3-5. Geographic Distribution for Earthquakes in the Continental U.S.



Source: U.S. Geological Survey (USGS), 2002b

Exhibit 3-6. Landslide Areas in the Contiguous U.S.



Source: USGS, 2002d

abilities to support certain applications or uses. In appropriate cases, soil and sediment properties must be examined for their compatibility with particular construction activities or types of land use. In a limited number of cases, the presence, distribution, quantity, and quality of mineral resources might affect or be affected by a proposed action.

Impact Assessment

Site preparation activities such as grading, vegetation removal, and reseeding, as well as construction, operation, transportation and intercept debris could cause ground disturbances, and therefore could impact geology and soils. Ground disturbances should be assessed for potential impacts such as substantial erosion, siltation, landslides or slumps, soil compaction, or impacts to permafrost areas. In addition, ground disturbances could impact valuable mineral deposits or prime or unique farmland (see Section 3.1.9, Land Use). Off-road vehicle activities for debris recovery or other activities could impact soils as well. The potential for impacts depends upon the geology and topography of the area. Seismic activity within a region of influence should be evaluated and standard measures for seismic safety implemented. For example, construction activities should consider information bearing on seismic design and construction standards, and a design engineer and geotechnical consultant should consider surface faulting potential. Some test activities could impact the stability of seismically active areas. The handling of propellants and other chemicals, as well as launch impacts, should be assessed for potential spills or ground cloud effects of contaminating soils. Best Management

Practices should be identified in the impacts analysis. For example, frequent watering of excavated material and/or use of soil additives to bond exposed surface soils would reduce potential for soil erosion. The analysis also should evaluate the potential for debris craters in impact zones, including impacts to ocean sediment. For test activities, a qualified accident response team would be available near launch locations to minimize any adverse effects from an unlikely event such as flight termination.

Determination of Significance

Actions that would result in uncontrolled soil erosion, uncontrolled contamination of soil, disruption of more than one-acre of permafrost soil, or that would increase the geologic seismic instability of an area would be considered significant.

3.1.7 Hazardous Materials and Hazardous Waste

Definition and Description

Hazardous materials and hazardous waste are defined by a number of U.S. regulatory agencies. In general, hazardous materials and hazardous waste include substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to the public health, welfare, or the environment when released. The EPA regulates hazardous chemicals, substances, and wastes under the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the Toxic Substances Control Act. In addition, the Occupational Safety and Health Administration (OSHA) has definitions and workplace safety-related requirements and thresholds for listed "hazardous and toxic substances,"[37] and the U.S. DOT has definitions and requirements for the safe transport of "hazardous materials."[38]

Hazardous Materials Management

Hazardous materials management is the responsibility of the cognizant authority operating facilities, installations or ranges. Maintenance and flight support operations at various locations may require the use of products containing hazardous materials, including paints, solvents, oils, lubricants, acids, batteries, fuels, surface coatings, and cleaning compounds. These products would be used and stored at appropriate locations throughout each site, but would be primarily associated with industrial and maintenance activities. Site-specific plans would outline the strategies and procedures for storing, handling, and transporting hazardous materials, as well as responding to on-site or off-site spills.

[37] OSHA, 2003
[38] DOT, 2003

Hazardous Waste Management

Federal and state regulations require that hazardous waste be handled, stored, transported, disposed of, or recycled in compliance with applicable regulations. Aircraft and vehicle maintenance, fuel storage and dispensing, and facility and grounds maintenance activities are MDA activity operations that could generate hazardous wastes. The sources of hazardous waste include waste fuel, chemical simulants, laser chemicals, waste oils, spent solvents, paint waste, and used batteries. Site-specific procedures and plans would outline the steps for appropriate management of hazardous wastes, such as satellite accumulation points and properly labeled DOT approved containers. Wastes may be disposed of using designated hazardous waste accumulation facilities or private hazardous waste contractors, as needed.

Impact Assessment

BMDS activities that could involve impacts from hazardous materials transport, disposal, storage, handling, and hazardous waste generation include site preparation and construction, prelaunch, launch/flight, and postlaunch activities and activation of laser weapons, sensors, and C2BMC. Site preparation activities could include exposure to previously contaminated sites. Missile build-out, fueling operations, or construction also may result in the handling of hazardous materials. The analysis should address the use of any ozone-depleting substances, such as refrigerants or foams.

Other toxic, corrosive, or flammable materials that personnel or environmental resources may be exposed to include asbestos, polychlorinated biphenyls, lead-based paint, radon gas, pesticides, petroleum and oils, chemical simulants, and propellants.

Any hazardous waste generated would be disposed of per appropriate state and Federal regulations. Federal military ranges would have established instructions to ensure proper handling and use of hazardous materials. Personnel involved in such operations would be trained in the appropriate procedures to handle hazardous materials and would wear protective clothing and receive specialized training in spill containment and cleanup. Any spills would be handled using established cleanup procedures. All tasks would be performed in accordance with standard operating procedures, and would include provisions for proper handling of hazardous materials/wastes and waste minimization.

Determination of Significance

Actions that would result in uncontrolled generation of hazardous materials or waste, actions that would require hazardous materials and do not have a closure or decommissioning plan, actions that would conflict with existing RCRA or other hazardous material or waste regulations, or actions that would expose the general public, unprotected MDA personnel, or wildlife to hazardous materials or waste that would result

in human or ecological health risk levels greater than 1 x 10^{-6} would be considered significant.

3.1.8 Health and Safety

Definition and Description

Health and safety includes consideration of any activities, occurrences, or operations that have the potential to affect the well being, safety, or health of workers or members of the general public. The primary goal is to identify and prevent accidents or impacts to on-site workers and the general public. In terms of the proposed action and alternatives, safety and health risks would occur primarily from accidents during construction, testing, operation, maintenance, or decommissioning activities. Safety and health risks may also occur from exposure to debris produced during test activities. The health and safety resource area addresses both occupational and environmental health and safety.

Occupational Health and Safety

Occupational health and safety deals with work sites and operational areas where workers would be located. (DOT, 2002) Typical potential hazards and accidents include

- Explosions of flammable liquids, solids, or compressed gases;
- Fires;
- Failures leading to fires or explosions involving boosters or other launch assets;
- Electrocution and burns from electrical equipment and currents;
- EM emissions (radars, lasers, infrared sensing devices);
- Inhalation or dermal exposure to hazardous materials or waste;
- Spills of chemicals and propellants;
- Falling debris related to construction and decommissioning;
- Confined spaces;
- Falls from structures;
- Accidents related to earth moving equipment and power tools; and
- Transportation accidents.

Hazard analyses are performed to identify and assess credible accident scenarios at work sites. The findings of a hazard analysis are used to establish health and safety procedures to prevent accident occurrences and to report and respond to any accidents that do occur.

Environmental Health and Safety

Environmental health and safety considers environmental quality both on and off the work site and operational areas that could impact the human health of the general public. Typical potential hazards and accidents include

- Explosions of flammable liquids, solids, or compressed gases;
- Fires;
- EM emissions (radars, lasers, infrared sensing devices);
- Spills of chemicals or propellants that contaminate surface or ground water;
- Inhalation of hazardous particulate and gaseous materials;
- Chronic/acute exposures to toxic/hazardous materials;
- Failures of electrical grids;
- Falling debris (e.g., from interceptor tests);
- Transportation accidents; and
- Personnel injury and equipment damage due to electrical shock.

Risk assessments are performed to identify, characterize, quantify, and evaluate risks to human health and the environment. A risk assessment considers both the likelihood or probability of occurrence and the consequences of accidents and hazardous events, including catastrophic ones. The results of a risk assessment are used to establish preventative and mitigating measures to reduce the risks to environmental quality and human health. Consideration of risk would also include debris modeling and analysis to determine the potential impact area in the event of a launch failure (including those launches requiring use of an FTS).

Impact Assessment

MDA activities with the potential to impact the health and safety of workers include construction; radar activation, laser weapon activation, missile storage, assembly, and transfer; and launch and post-launch activities. Any debris recovery and emergency operations also could impact worker health and safety. The areas of potential impacts to the health and safety of the public include prelaunch transport of missiles, launches, radar activation, laser activation, and missile flight. The potential impacts of a launch failure should be analyzed. Launch failure could involve an explosion, falling missile debris, release of toxic materials into the air or water, high noise levels, and/or fire.

Handling and assembly of missile components, which are typically accomplished within enclosed buildings, have the potential to affect worker health and safety. Range Commanders Council Standard 321-02 limits the collective risks to 1×10^{-3} for non-mission essential personnel and to 1×10^{-2} for mission essential personnel. If a launch site malfunction occurs, it could result in the scattering of the resulting missile debris anywhere within the LHA. A probabilistic risk analysis would be performed before each flight test to determine that individuals of the general public would not be exposed to a probability of fatality greater than 1 in 10 million for any single mission and 1 in 1 million on an annual basis, as per the Range Commander's Council Standard 321-02. Site-specific environmental documents would identify and, if appropriate, analyze required health and safety regulations for individual sites where activities for the

proposed BMDS may occur. Compliance with Federal, state and local regulations would be required.

Federal military ranges would have specific regulations to ensure the health and safety of members of the range as well as the public in the surrounding area. Applicable safety regulations would be followed in the transport, receipt, storage, and handling of hazardous materials. All shipping would be conducted under DOT regulations. Transportation and loading practices would meet Federal, state, and local regulatory and safety requirements.

Determination of Significance

Actions that would not fall under the existing health and safety operating procedures of the facility or range where such actions would occur, actions that would conflict with existing OSHA regulations, or actions that would result in a level of risk that exceeds the Range Commanders Council Standard 321-02 to the health and safety of the general public and MDA personnel would be considered significant.

3.1.9 Land Use

Definition and Description

Land use is described as the human use of land resources for various purposes, including economic production, natural resource protection, or institutional uses. Land uses frequently are controlled by management plans, policies, ordinances, and regulations that determine the uses that are permissible or protect specially designated or environmentally sensitive areas (e.g., prime farmlands, coastal zones, national parks, historic properties). Planning departments at the local and municipal level typically designate land uses for specific areas, which describe the permitted development activities that are acceptable for the area, such as agricultural, residential, commercial, and industrial.

Public land may be assigned specific designations for which land use and management guidelines are provided. These designations include

- Controlled use or wilderness areas;
- Limited use areas, which protect sensitive, natural, ecological, scenic, and cultural resource values;
- Low intensity regions, which carefully control multiple uses of resources and ensure sensitive values are not significantly diminished;
- Moderate use regions, which provide for a controlled balance between higher intensity uses and resource protection; and
- Intensive use regions, which provide for concentrated use of lands and resources to meet human needs.

Types of land use include agriculture, livestock grazing and production, conservation and recreation sites, military installations, and research sites managed by other agencies and organizations. A particular environment may include cities, towns, and rural communities of all sizes, throughout which are extensive communication systems; industrial complexes with factories and power plants; energy distribution systems for electricity, natural gas, liquid fuels, and nuclear, solar, hydro, and wind power; water treatment facilities; and waste management facilities. Wildlife refuges, national landmarks, and coastal zones present within an environment typically are afforded special status or protection.

A given site for proposed BMDS activities may include launch sites, impact areas, instrumentation sites, facilities, and equipment. On-site land use designations may include flight line zones, test ranges, support service areas, and explosive hazard zones. Land use categories for each site may be defined independently. Differences in terminology for land use classification among facilities where activities for the proposed BMDS may occur can be attributed to the local nature of land use classification, the unique circumstances at a particular facility, or the different interpretations of widely used terms (e.g., industrial, open space). Each land use category depends on a variety of factors, including the level of residual hazards and the risks associated with potential exposures.

The combined efforts of state, county, local, and on-site plans may regulate land use within the boundaries of a particular installation. Facilities where proposed BMDS activities may occur may use a wide range of planning documents as their land use plans, including legal settlement agreements narrowly tailored to designating land uses; comprehensive site plans incorporating all planning information, including current and future land uses, budget projections, and institutional plans; and a hierarchy of multiple planning documents. Wide variation in the level and types of coordination between site personnel and off-site communities regarding land use planning issues may occur. The variation appears to depend on the site's mission, closure schedule, proximity to local off-site development, and level of community interest. On-site land use management plans may address the security of essential mission activities from encroachment and the protection of both human and natural environments.

Impact Assessment

Numerous land use designations may characterize a given environment and the sites located within that environment. As a result, site-specific analysis will identify and, if appropriate, analyze potential impacts to particular land use designations for individual sites where activities for the proposed BMDS may occur. Compliance with Federal and state regulations and local land use plans would be required. Site-specific analysis would be coordinated with the appropriate agencies, including the Bureau of Land Management, National Park Service, U.S. Department of Agriculture Forest Service, and state agencies,

as well as county and municipal planning groups and local communities. At some facilities, it may be necessary to address the issue of encroachment to ensure that off-site development is not encroaching on the site where activities for the proposed BMDS may occur.

Determination of Significance

Actions that would require modification to an existing land use plan of an installation or range, or would preclude existing land use activities at lands adjacent to the action that are not owned by DoD or for which no easement exists between the land owner and the DoD for longer than one week, actions that would disrupt or divide established land use configurations or represent a substantial change in existing land uses, actions that would require the use of other Federal lands where an existing use agreement has not been prepared and authorized by both Federal Agencies, or conflict with existing regulations and policies governing land use (e.g., Coastal Zone Management Act) would be considered significant.

3.1.10 Noise

Definition and Description

Noise is often defined as unwanted or annoying sound that is typically associated with human activity. Most sound is not a single frequency, but rather a mixture of frequencies, with each frequency differing in sound level. The intensities of each frequency combine to generate sound, which usually is measured and expressed in decibels (dB). Decibels are measured on a logarithmic scale, which means that a doubling of sound energy or number of sources producing the same sound level will result in a three dB increase. A 3 dB increase is considered just noticeable to most people, while a 10 dB increase is considered a doubling of perceived loudness.

- **A-weighted decibels (dBA)**. Most measures of noise for community planning purposes use dBA, which are used to characterize noise as heard by the human ear.

- **Community Noise Equivalent Level**. The Community Noise Equivalent Level describes the average sound level during a 24-hour day in dBA. For noises occurring between 7:00 p.m. and 10:00 p.m., five dBA are added to the measured noise level, and for noises occurring between 10:00 p.m. and 7:00 a.m., 10 dBA are added to the measured noise level.

- **Day night average noise level (DNL)**. DNL is the energy average noise level during a 24-hour day. It is reported in dBA and is used to predict human annoyance and community reaction to unwanted sound (noise). Because humans are typically more

sensitive to noise in the evening, the DNL places a 10-dBA penalty on noise produced between the hours of 10:00 p.m. and 7:00 a.m.

- **Equivalent Noise Level (L_{eq})**. The L_{eq} is the energy average A-weighted sound level during a stated measurement period. It is used to describe the time-varying character of environmental noise.

- **Pounds per Square Foot**. Pounds per square foot is a measure of pressure. Some activities of the proposed BMDS may produce pressure waves in the form of sonic booms that can cause damage to eardrums and structures.

Examples of A-weighted noise levels for various common noise sources are shown in Exhibit 3-7.

Exhibit 3-7. Comparative A-Weighted Sound Levels

Noise Level (dBA)	Common Noise Levels	
	Indoor	**Outdoor**
100 – 110	Rock band	Jet flyover at 304 meters (997 feet)
90 – 100	Food blender at one meter (three feet)	Gas lawnmower at one meter (three feet)
80 – 90	Garbage disposal at one meter (three feet)	Diesel truck at 15 meters (49 feet) - Noisy urban daytime
70 – 80	Shouting at one meter (three feet) Vacuum cleaner at three meters (ten feet)	Gas lawnmower at 30 meters (98 feet)
60 – 70	Normal speech at one meter (three feet)	Commercial area heavy traffic at 100 meters (328 feet)
50 – 60	Large business office Dishwasher next room	
40 – 50	Small theater (background) Large conference room (background)	Quiet urban nighttime
30 – 40	Library (background)	Quiet suburban nighttime
20 – 30	Bedroom at night	Quiet rural nighttime
10 – 20	Broadcast/recording studio (background)	
0 – 10	Threshold of hearing	

Source: Modified from FAA, 2001

Noise from transportation sources, such as vehicles and aircraft, and from continuous sources, such as generators, would be assessed using the A-weighted DNL. The A-

weighted DNL significantly reduces the measured pressure level for low-frequency sounds, while slightly increasing the measured pressure level for some high-frequency sounds. Noise from small arms ranges is assessed using the A-weighted DNL. Impulse noise resulting from armor, artillery, and demolition activities is assessed in terms of the C-weighted DNL. The C-weighted DNL is often used to characterize high-energy blast noise and other low frequency sounds capable of inducing vibrations in buildings or other structures. The C-weighted scale does not significantly reduce the measured pressure level for low frequency components of a sound.

Impact Assessment

The acceptability of noise depends in part on expectations associated with land use. An urban environment is noisier than a suburban environment, and a suburban environment is noisier than a rural one. Exhibit 3-8 provides a range of DNL values by land use type.

Exhibit 3-8. Examples of Outdoor Day-Night Average Noise Levels in Various Land Use Locations

Outdoor Location	DNL in dB
Apartment next to freeway	88
¾ mile from touchdown at major airport	86
Downtown with some construction activity	79
Urban high density apartment	78
Urban row housing on major avenue	68
Old urban residential area	59
Wooded residential	51
Agricultural crop land	44
Rural residential	39
Wilderness ambient	35

Source: EPA, 1978

Exhibit 3-9 lists noise measurements that were recorded at some existing facilities where launch activities have taken place, which encompass various environmental settings.

Site-specific analysis would identify and, if appropriate, analyze potential impacts from noise levels at individual sites where activities for the proposed BMDS may occur. Noise impacts resulting from activities associated with the proposed BMDS may include but are not limited to construction activities, missile launches, and use of generators. Three types of receptors are typically analyzed: humans, wildlife, and structures. For each type of receptor, the potential impacts of noise would need to be analyzed in site-specific analyses.

Exhibit 3-9. Range of Noise Measurements

Measurement Locations		Noise Level (dBA)
Remote desert environments[39]		22-38
Interstate interchanges (non-urban)[40]		55-70
Marshall Space Flight Center (wooded area with insects dominating the higher reading)[41]		40-54
Vandenberg AFB[42]		48-67
Edwards AFB (with some areas off base at 80 dBA)[43]		65-85
WSMR[44]	Main post	55-65
	Property boundary	45-55
	Nearby San Andreas National Wildlife Refuge	45
Eastern Range[45]		60-80
KLC[46]	Approximately 1,905 meters (6,250 feet) from center of pad	95
	Distance of 9 to 24 kilometers (5.6 to 15 miles) from the launch pad	70

Source: Modified from DOT, 2001b

Launch Activity Noise

Noise during launch activities would occur due to the rocket engine. Noise generated during launch would result from the interaction of the exhaust jet with the atmosphere and the combustion of the fuel. The sound pressure from a missile is related to the engine's thrust level and other design features. Workers exposed to excessive launch noise would be required to wear hearing protection.

Sonic booms also would be generated during launches when the launch vehicle reached supersonic speed. A sonic boom is a sound that resembles rolling thunder, and is produced by a shock wave that forms at the nose of a vehicle that is traveling faster than

[39] Estimate, no other specifics given
[40] Monitoring data, no other specifics given
[41] One-hour monitoring
[42] Twenty-four hour monitoring
[43] Monitoring data, no other specifics given
[44] Estimate, no other specifics given
[45] Daytime monitoring
[46] Rocket noise levels from launch of U.S. Air Force atmospheric interceptor technology test vehicles

the speed of sound. The sound heard at the Earth's surface as the "sonic boom" is the sudden onset and release of pressure after the buildup by the shock wave or "peak overpressure."

Construction Noise

In addition to operational noise, construction would result in intermittent, short-term noise effects that would be temporary, lasting for the duration of the noise generating construction activities. Noise-generating construction activities would include excavation and grading, utility construction and paving, and frame building. The specific types of equipment that would be used during construction would be identified in site-specific analyses. Excavation and grading would normally involve the use of bulldozers, scrapers, backhoes, and trucks. The construction of buildings likely would involve the use of pile drivers, concrete mixers, pumps, saws, hammers, cranes, and forklifts.

Power Generation Noise

The use of power generators should not exceed locally regulated noise levels or facility specific noise levels. The noise associated with generators would be controlled by use of standard silencing packages (mufflers) provided by the manufacturer and routine maintenance and inspection of such systems.

<u>Human Response</u>. Noise from single events can be annoying due to noise level, duration of the event, how loud the event is relative to ambient sound levels, and the frequency of occurrence. Additional annoyance can be attributable to a 'startle effect' associated with a sonic boom. Site-specific analysis will identify and, if appropriate, analyze potential impacts from noise levels at individual sites where activities for the proposed BMDS may occur. Compliance with Federal as well as state and local regulations will be required. (EPA, 1978, as referenced in DOT, 2001b)

The annoyance experienced as a result of sonic booms has been widely studied both in the field and in laboratory settings. Annoyance is generally considered to be a function of boom intensity, number of booms per time period, attitude of the population, and the activity in which people were engaged in at the time of the boom. However, there is no precise relationship between the parameters. One study was done to determine the reactions of people routinely exposed to sonic booms (eight sonic booms per day) over a six-month period. This study found that sonic boom annoyance increases as the number and or level of sonic booms increases. (DOT, 2001b) In that study, approximately 20 percent of the population reported annoyance from sonic booms with median peak overpressures of 0.5 psf. Another study suggested that prior experience with sonic booms (such as people who live on an AFB) seems to lower sensitivity to sonic booms. (DOT, 2001b) Other factors that influence the loudness and annoyance are the rise time of the sonic boom and shape of the waveform. (DOT, 2001b) In general, some public

reaction can be expected if occasional sonic booms with peak overpressures between 1.5 and 2 psf impact populated areas (NASA, 1994), but it is possible that at lower amplitudes people can express annoyance to sonic booms. The impacts assessment would include the number, frequency, location, and intensity of sonic booms, and identify affected receptors.

Structural Response. Sonic booms also may cause structural damage, which could impact prehistoric and historic resources. Vibrations from the sonic booms could disturb existing cultural and historic structures, especially those that are not structurally sound. The impacts assessment would identify and evaluate effects on existing cultural resources and historic structures.

Wildlife Response. Responses of wildlife would vary based on the type of noise and its characteristics (amplitude, rise time, duration, frequency content), the species of wildlife, hearing capability, location, habitat type, current activity of the animal, sex and age, previous experience with noise exposure, and condition of the animal. (Manci, 1988) Potential physiological impacts from noise can range from short-term mild impacts, such as an increase in heart rate or small temporary changes in hearing, to more damaging impacts, such as permanent changes in hearing, metabolism, and hormone balance, to long-term severe impacts, such as chronic distress that is harmful to the health of wildlife species and their reproductive fitness. (DOT, 2001b) Potential behavioral impacts from noise also range greatly from minor responses, including small changes in current behavior such as, a “heads up” response, to more severe responses, such as panic and escape flight responses that might result in physiological damage (falling, trampling, crashing, piling). Behavioral responses of wildlife to noise also can accompany physiological responses. The impacts assessment would identify and evaluate effects on affected wildlife, including threatened and endangered species and migratory populations.

Hearing Damage

The OSHA regulation 1910.95 establishes a maximum noise level of 90 dBA for a continuous eight-hour exposure during a working day and higher levels for shorter exposure time in the workplace. The OSHA standards allow for a 5 dBA increase in sound level for a 50 percent reduction in exposure time. Therefore, the maximum noise exposure permitted under the regulation for continuous exposure would be 115 dBA for 15 minutes. (FAA, Aviation Noise Effects, 1985) Other standards have also been recommended for exposure to continuous noise. The EPA has recommended an average L_{eq} of 70 dBA for continuous 24-hour exposure to noise to protect hearing. This level is considered conservative and is based on the probability of negligible hearing loss, defined as less than 5 dB in 100 percent of the exposed population, at the human ear’s most sensitive frequency (4,000 hertz) after a 40-year exposure. (FAA, 1985) Noise also

may be impulsive in nature. Under OSHA regulation 1910.95 exposure to impulse noise should not exceed 140 dBA.

Determination of Significance

Federal and state agencies that regulate noise handle the determination of significant noise impact differently. For example, the FAA considers the threshold of a significant impact to be a 1.5 dBA increase from 65 DNL (FAA Order 1050.1E) Federal Highway Administration (FHWA) does not employ significance thresholds for noise; rather, FHWA uses Noise Abatement Criteria (NAC) where noise abatement is considered (where reasonable and feasible) for EISs as well as EAs. The NAC vary by land use—the residential NAC is 66 dBA, 1 hour L_{eq}. FHWA considers both absolute and relative noise impacts. A relative noise impact refers to the amount of project-related noise increase above ambient noise levels.

Potential BMDS noise impacts could be associated with a wide range of noise sources and noise environments. For example, a generator produces a steady-state noise, with moderate noise levels and limited geographic effect. A missile launch could produce high noise levels for a short duration with little to no exposure in populated areas. Because NEPA requires ‘context and intensity’ in consideration of significant impact, these disparate noise situations potentially call for different definitions of significance. Therefore, the details of what would comprise a ‘significant’ noise impact for the PEIS will be developed and considered on a case-by-case basis.

3.1.11 Socioeconomics

Definition and Description

Socioeconomics is defined as the basic attributes and resources associated with the human environment, in particular population and economic activity. Socioeconomic resources consist of several primary elements including population, employment, and income. Other socioeconomic aspects that are described often may include housing and employment characteristics, and an overview of the local economy.

Impact Assessment

Potential socioeconomic impacts from MDA activities may stem from construction or operation of the BMDS. The magnitude of the impacts would depend on the duration and extent of displacement or modification of existing activities and the diversion or temporary suspension of access. Impact analyses should focus on the following broad areas of economic or social impacts: employment and income; growth inducement; potential impacts to locally significant industries such as tourism, commercial fishing, or

agriculture; displacement of populations, residences, or businesses; and housing or accommodation availability.

Employment and Income

Activities for the proposed BMDS could have a positive economic impact in local communities due to increased jobs in the defense industry. These jobs generally are technology-based and require workers with specialized skills and education. These jobs would contribute to local economies by increasing personal income, thereby increasing the tax base. In addition, an increase in workers in a particular area increases the need for services, which creates more jobs in other industries, such as retail, food services, education, and health.

Local Economies

Additional construction personnel, by spending money in the local economy, mainly via accommodation and procurement of goods and services, would represent both a potential increase in local service-based employment opportunities and a small but positive temporary economic impact to the local community. Site-specific documentation would be required for comprehensive analysis of impacts to local economies.

Displacement Impacts

Some missile defense activities could result in a negative economic impact from displacement of populations, residences or businesses; housing or accommodation availability. For example, health care facilities, housing, and other infrastructure may be insufficient in some areas to support an influx of workers during construction. Testing and operation activities also may require an influx of additional personnel into the area. Proposed activities also could cause displacement of populations during test events and potential impacts to local industries such as tourism, or agriculture due to the closure of these areas during test events. Proposed activities could cause a loss in property value due to adjacent test activities. Site-specific analyses would be required to determine the magnitude of the potential for impact.

Determination of Significance

Significant economic or social impacts do not require preparation of an EIS unless those impacts are combined with significant impacts from other resource categories (see 40 CFR 1504.14). Actions that would disrupt local or regional economies or would displace or introduce a new population that would substantially alter the socioeconomic setting, or actions that would cause a ten percent increase in the risk of crime or other undesirable social factors would be considered significant.

3.1.12 Transportation

Definition and Description

The transportation section addresses ground, air, and marine transport systems.

According to the most recently available data, the U.S. has over four million miles of highways, railroads, and waterways that connect all parts of the country. It also has 19,000 public and private airports and approximately 1.6 trillion miles of oil and gas distribution pipelines. This extensive transportation network supported about 4.9 trillion passenger-miles of travel in 2001 and 3.8 trillion ton-miles of commercial freight shipments in 2001. The U.S. transportation system, one of the world's largest, serves 284 million residents and seven million business establishments. (DOT Bureau of Transportation Statistics [BTS], 2003)

Metropolitan areas are characterized by urban transit, a complex mix of heavy, light, and commuter rail; buses and demand responsive vehicles; ferries; and other less prevalent types such as inclined planes, trolley buses, and automated guide ways. More than one-third of America's population lives outside of urbanized areas, which typically do not have extensive transit systems.

Paved roadways constituted about 65 percent of all highway mileage in 2001. Nearly all of the public roads in U.S. urban areas are paved, however, about half of the miles of rural public roads are unpaved. In 2001, 71 percent of U.S. roads were classified as being in good or very good condition and 14 percent as mediocre or poor. The remaining 15 percent were classified as fair. The generally poorer condition of urban roads, as compared with rural roads, can be attributed to the higher levels of traffic they carry. (DOT BTS, 2003) Urban roads handled about 60 percent of all traffic in 2000 with far fewer miles of road. (DOT BTS, 2001)

The most heavily populated states, California, Texas, Florida, and New York, are the most heavily traveled. However, Wyoming, the least populated state, had the highest vehicle-miles of travel per capita in 2000 at 16,400, followed by Georgia, Alabama, Oklahoma, and New Mexico at over 12,500. The District of Columbia and New York had the lowest vehicle-miles of travel per capita at less than 7,000. (DOT BTS, 2001) Landside access to water ports comprises a system of intermodal rail and truck services. Landside congestion, caused by inadequate control of truck traffic into and out of port terminals combined with the lack of adequate on-dock or near-dock rail access, affects the productivity of U.S. ports and the flow of U.S. international trade. Changes in vessel design impact access to both landside and waterside services. For example, container vessels have increased in size and capacity, which, in turn, drives a need for adequate trans-shipment hub and feeder ports.

Ground Transportation

Ground transportation and traffic circulation refer to the movement of vehicles from origins to destinations through a road and rail network. Roadway operating conditions and the adequacy of the existing and future roadway system to accommodate these vehicular movements usually are described in terms of the volume-to-capacity ratio, which is a comparison of the average daily traffic volume on the roadway to the roadway capacity. The volume-to-capacity ratio corresponds to a Level of Service (LOS) rating, ranging from free-flowing traffic conditions (LOS A) for a volume-to-capacity of usually less than 30 percent of the roadway capacity to forced-flow, congested conditions (LOS F) for a volume-to-capacity of 100 percent of the roadway capacity. LOS A, B, and C are considered good operating conditions where motorists experience minor delays. LOS D represents below average conditions, and LOS E corresponds to the maximum capacity of the roadway. LOS F indicates a congested roadway.

Railway operating conditions and safety standards in the U.S. are regulated by the U.S. DOT, Federal Railroad Administration. The Federal Railroad Administration has established standards for nine types of track (Class 1 through 9); each class has unique construction, maintenance, and inspection standards, as well as operational requirements. Class 1 track is the minimum acceptable standard for general use and has a 16 kilometer per hour (ten mile per hour) speed limit for freight and a 24 kilometer per hour (15 mile per hour) speed limit for passengers. Class 9 track has the most stringent track standards and allows both freight and passenger trains to travel up to 322 kilometers per hour (200 miles per hour). Local regulations, e.g., city speed limits, may reduce speeds regardless of track quality. (DOT, FRA 2002)

Air Transportation

Air transportation refers to the movement of aircraft through airspace. The control of airspace used by air traffic varies from very highly controlled to uncontrolled areas. Examples of highly controlled air traffic situations are flight in the vicinity of airports, where aircraft are in critical phases of flight (take-off and landing), flight under IFR, and flight on the high or low altitude route structure (airways). Less controlled situations include flight VFR or flight outside of U.S. controlled airspace (e.g., flight over international waters off the coast of California, Hawaii, or Alaska).

Marine Transportation

Marine traffic is the transportation of commercial, private, or military vessels at sea, including submarines. Marine traffic flow in congested waters, especially near coastlines, is controlled by the use of directional shipping lanes for large vessels (cargo, container ships, and tankers). Traffic flow controls also are implemented to ensure that harbors and ports-of-entry do not become congested. There is less control on ocean

traffic involving recreational boating, sport fishing, commercial fishing, and activity by naval vessels. However, U.S. Navy vessels follow military procedures and orders (e.g., Fleet Forces Command) as well as Federal, state, and local marine regulations. In most cases, the factors that govern shipping or boating traffic include adequate depth of water, weather conditions (primarily affecting recreational vessels), the availability of fish of recreational or commercial value, and water temperature (higher water temperatures will increase recreational boat traffic and diving activities).

Impact Assessment

General transportation impacts can be assessed by determining the existing traffic flow and LOS. MDA activities that could cause impacts to the LOS include the increased delivery of construction equipment, propellants, or test event equipment, and the influx of construction workers or test operation personnel. In addition, roads, ports, or waterways within the LHA may be closed during test events. Roads also may be closed during the arrival of missile payloads and/or boosters to ensure that roadways near a Range would be vacated.

The region of influence in determining impacts would depend on local traffic volume and transportation infrastructure. At the programmatic level, analysis shows that construction events and associated increases in transport of equipment and personnel are typically short-lived. However, site-specific analyses should be completed to determine local conditions.

Determination of Significance

Actions that are not included as categorical exclusions in DoD's NEPA implementing regulations, or actions that would require the movement of an extremely hazardous, toxic or radiological substance, would generate traffic levels that would require construction of new roadways or expansion of existing roadways, alteration of circulation patterns, or would result in inadequate parking, transportation actions that would result in multi-day disruptions (more than two days) of marine or air traffic shipping lanes would be considered significant. In addition, actions that would result in road closures for more than two days or closures of major highways for more than one hour during peak traffic hours would be considered significant.

3.1.13 Utilities

Definition and Description

The purpose of the utilities section is to address the existing rate of consumption, generation, and distribution of utilities, which include energy, water, wastewater, and solid waste and construction debris. This section address those facilities and systems that

provide power, water, wastewater treatment, the collection and disposal of solid waste, and other utility services.

- **Energy**. Energy refers to the power that is produced by a central electrical power plant or, in some cases, by individual power generators. The power would be utilized for both construction and operational activities on different sites.

- **Water**. Water refers to the system that produces water, the treatment system that purifies the water, and the network that distributes that water. This water system usually is controlled, managed, and distributed by an entity such as a utility purveyor. In the absence of a water system, individualized water wells or a series of wells meet the demand for water. The water system is identified by potable, or drinkable, freshwater and nonpotable water used for other activities such as construction, operations, and irrigation. In some cases the non-potable system is saltwater. The water system is composed of a source that produces the water and the treatment systems that cleanse and purify it, making it available for use. Water made available to the public must meet EPA standards as described in Section 3.1.15.

- **Wastewater**. There are different methods of treating wastewater that is produced by a site. Wastewater can be collected in a central system and then directed to a treatment plant where it can be treated and then discharged. In many instances, the wastewater is further treated and reclaimed for use as nonpotable water. In the absence of a central system, septic systems collect and treat water either individually (individual households) or collectively (within a community).

- **Solid Waste**. Solid waste disposal includes the collection, handling, and disposal of waste. Designated landfills within an area or region are the final destinations where solid waste and construction debris is transported for processing. Solid waste usually is processed to separate out recyclable products first. Solid waste disposal also includes practices such as open burning, septage disposal, and burial in open or excavated trenches, where allowed by law.

Impact Assessment

A site-specific impact assessment should consider whether there is adequate wastewater treatment capacity or capability and if the proposed action would exceed wastewater treatment requirements and alter the existing rate of consumption, generation, and distribution of utilities. An impact analysis should include an evaluation of waste disposal facilities and landfills and waste discharge requirements. MDA activities require consistent power sources, and depletion of an existing power supply from a central electric power plant or individual power generators should be considered. Assessment of potential impacts on utilities would include a review and analysis of

- Wastewater treatment requirements of the applicable Regional Water Quality Control Board or other governing authority;
- Availability of sufficient water supplies to serve the proposed action, or need for new or expanded entitlements;
- Availability of waste disposal facilities and landfills with sufficient permitted capacity to accommodate solid waste disposal needs;
- International treaties and Federal, state, and local statutes and regulations related to solid waste; and
- Capacity of the existing power supply providers and wastewater treatment providers to determine whether they could adequately serve the projected demand of the proposed action, in addition to the provider's existing commitments.

Determination of impacts on utilities also would include consideration of whether the proposed action would require or result in the construction of new water or wastewater treatment facilities, new storm water drainage facilities, or energy sources beyond permitted levels. Construction of new facilities or expansion of existing facilities has the potential to cause significant environmental impacts. It would be necessary to obtain appropriate permits for activities that may impact utility systems and facilities and to ensure compliance with local laws and regulations.

Site-specific analysis would be required to identify and, if appropriate, analyze potential impacts to a local utility system for individual activities for the proposed BMDS. For this reason, this PEIS will not include an analysis of the proposed BMDS activities' impacts on utilities.

Determination of Significance

Actions that would result in exceeding the existing capacity of the regional utility service providers (water supply, wastewater disposal, electricity, natural gas, solid waste disposal) and would require the identification or development of new utilities, supplies (water, electricity, natural gas), or disposal facilities (wastewater treatment facilities or solid waste disposal facilities) and their associated utility transmission corridors would be considered significant.

3.1.14 Visual Resources

Definition and Description

Visual resources are defined as the natural and man-made features that constitute the aesthetic qualities of an area. Landforms, surface water, vegetation, and man-made features are the fundamental characteristics of an area that define the visual environment and form the overall impression that an observer receives of an area. The importance of visual resources and any changes in the visual character of an area is influenced by social

considerations, including the public value placed on the area, public awareness of the area, and community concern for the visual resources in the area.

The visual resources of an area and any proposed changes to these resources can be evaluated in terms of "visual dominance" and "visual sensitivity." Visual dominance describes the level of noticeability that occurs as the result of a visual change in an area. The levels of visual dominance vary from "not noticeable" to a significant change that demands attention and cannot be disregarded. Visual sensitivity depends on the setting of an area. Areas such as coastlines, national parks, and recreation or wilderness areas usually are considered to have high visual sensitivity, whereas heavily industrialized urban areas tend to have the lowest visual sensitivity.

The significance of visual effects is very subjective and depends upon the degree of alteration, the scenic quality of the area disturbed, and the sensitivity of the viewers. The degree of alteration refers to the height and depth of maximum cut and fill areas and the introduction of urban elements into an existing natural environment or a substantial increase of structural elements into an already urban environment, while acknowledging any unique topographical formation or natural landmark. Sensitive viewers are those who utilize the outdoor environment or value a scenic viewpoint to enhance their daily activity and are typically residents or recreation users. Changes in the existing landscape where there are no identified scenic values or sensitive viewers are considered less than significant. Also, it is possible to acknowledge a visual change as possibly adverse but not significant, because either viewers are not sensitive or the surrounding scenic quality is not high. Visual impacts also would occur if proposed development is inconsistent with existing goals and policies of jurisdictions in which the project is located.

Many environments are likely to include regions of rich aesthetic and visual resources as well as designated and undesignated natural areas of great beauty and scenic diversity. Visual resources may fall under several different designations including national forest; national monument; national, state, and county parkland; national wildlife refuges; wilderness areas; wild and scenic rivers; national trails; and privately owned land. Various roads also may be designated scenic byways due to their scenic, historic, and cultural qualities. Visually sensitive recreational areas or scenic highways may be located in close vicinity of a site where activities for the proposed BMDS may occur.

Installations where MDA activities for the proposed BMDS may occur are typically dominated by developed, high technology buildings and support facilities. Some existing military sites are relatively unobtrusive when viewed from surrounding areas; however, it is possible that a variety of visual and aesthetic resources may be located near sites where activities for the proposed BMDS may occur.

Impact Assessment

MDA activities could have aesthetic impacts associated with changes in either the built or natural environment. An impacts analysis should include the length of visual disturbance (short- or long-term).

Assessment of potential impacts on visual resources should include a review and analysis of

- Short-term visual impacts such as the presence of heavy machinery during construction of a project (large trucks, cranes, and other construction equipment would be visible within the construction zone and in surrounding areas only during the construction phase.);
- Long-term visual changes such as those associated with altering the existing visual environment by constructing buildings, including those with high vertical profiles;
- Existing scenic resource, including but not limited to trees, rock outcroppings, and historic buildings within a state scenic highway;
- Existing visual character or quality of a site and its surroundings;
- New sources of substantial light or glare, which could adversely affect day or nighttime views in the area (for example, nighttime lighting, particularly during construction can cause impacts to visual resources);
- Viewer concern, or the level of scenic importance based on expressed human concern for the scenic quality of land;
- Distance an area can be seen by observers and the degree of visible detail within that area; and
- Extent of modification that would occur as a result of the proposed action.

Numerous visual and aesthetic resources may be identified in a given environment and at or near BMDS installations located within that environment. As a result, site-specific environmental documentation will identify and, if appropriate, analyze potential impacts to visual and aesthetic resources located in the vicinity of sites where activities for the proposed BMDS may occur. For this reason, this PEIS will not include an analysis of the proposed BMDS activities' impacts on visual resources.

Determination of Significance

Actions that would be considered significant include those that involve structures or land alterations that are visually incompatible with or obtrusive to the existing visual setting and landscape, noticeably increase visual contrast and reduce the scenic quality rating, permanently block or disrupt existing views or reduce public opportunities to view scenic resources, or conflict with existing regulations and policies governing aesthetics and visual resources (e.g., National Historic Preservation Act).

3.1.15 Water Resources

Definition and Description

Water resources include surface water, ground water, and floodplains. Surface water resources consist of lakes, rivers, and streams. Surface water is important for its contributions to the economic, ecological, recreational, and human health of a community or locale. Storm water flows, which may be exacerbated by high proportions of impervious surfaces (e.g., buildings, roads, and parking lots), are important to the management of surface water. Storm water also is important to surface water quality because of its potential to introduce sediments and other contaminants into lakes, rivers, and streams.

Ground water consists of the subsurface hydrologic resources. It is an essential resource often used for potable water consumption, agricultural irrigation, and industrial applications. Ground water typically may be described in terms of its depth from the surface, aquifer or well capacity, water quality, surrounding geologic composition, and recharge rate.

Floodplains are areas of low-lying ground along a river or stream channel. Such lands may be subject to periodic or infrequent inundation due to rain or melting snow. Risk of flooding depends on topography, the frequency of precipitation events, and the size of the watershed above the floodplain. Often development in floodplains is limited to passive uses, such as recreational and preservation activities, to reduce the risks to human health and safety.

The National Water Quality Inventory summarizes the water quality assessments performed by state, local and Tribal governments. (EPA, 2000) Water quality standards consist of three elements: (1) designated uses assigned to water body (e.g., drinking, swimming, and fishing); (2) criteria to protect the designated use (e.g., chemical specific threshold limits); and (3) anti-degradation policy to prevent deterioration of current water quality. The status of the U.S. water quality in 2000 is described in Exhibit 3-10.

Exhibit 3-10. Summary of Quality of Assessed Rivers, Lakes, and Estuaries

Water Body Type	Total Size, approximate	Amount Assessed* (Percent of Total)	Good (Percent of Assessed)	Good but Threatened (Percent of Assessed)	Polluted (Percent of Assessed)
Rivers, kilometers [miles]	5.94 million (3.7 million)	19 percent	52 percent	98 percent	38 percent
Lakes, hectares [acres]	16.4 million (40.6 million)	43 percent	46 percent	8 percent	44 percent
Estuaries, square kilometers [square miles]	22,630 (87,370)	36 percent	45 percent	<43 percent	50 percent

Source: EPA, 2002
*Includes water bodies assessed as not attainable for one or more uses
Note: percentages may not add up to 100 percent due to rounding

The leading causes of impairment of rivers and streams include pathogens (bacteria), siltation (sedimentation), and habitat alterations, and the leading sources for these include agriculture, hydraulic modifications, and habitat modifications. The leading causes of impairment of lakes, ponds and reservoirs include nutrients, metals (primarily mercury), and siltation (sedimentation), and the leading sources for these include agriculture, hydraulic modifications, and urban runoff/storm sewers. The leading causes of impairment of estuaries include metals (primarily mercury), pesticides, and oxygen-depleting substances, and the leading sources for these include municipal point sources, urban runoff/storm sewers, and industrial discharges. (EPA, 2002)

Impact Assessment

MDA activities that could impact water resources include those that either alter the flow of surface water, supply of ground water, or in some way contribute foreign bodies (pollution, sediment) to these water resources.

Assessment of potential impacts on water quantity would include a review and analysis of activities that

- Increase the number of impervious surfaces in an environment such as construction of new roads, buildings, parking lots, launch pads or runways (these surfaces can impact storm water runoff and recharge of ground water sources); and

- Consume ground water or surface water for a particular facility (the availability of water resources varies between locations).

Assessment of potential impacts on water quality would also include a review and analysis of activities that result in emissions or discharge of pollutants to water resources such as

- Construction or operation activities that could contribute to the sedimentation of water bodies; and
- Causes of point and non-point source pollution such as transportation emissions and ground clouds from launch, runoff of deluge or wash down water, thermal discharges, debris impacts, and any plans for open burning/open detonation.

Individual construction projects and associated water demands cannot be considered at the programmatic level, but must be analyzed in site-specific environmental documentation that can assess the impacts of such activities. This PEIS addresses the general impacts of BMDS activities resulting in sedimentation and pollution on water resources.

Determination of Significance

Actions that would fill in jurisdictional wetlands at levels that exceed the criteria for a Nationwide Permit and would require consultation with the U.S. Army Corps of Engineers and the development and implementation of a mitigation plan would be considered significant. Actions that would violate or exceed existing National Discharge Elimination System or Total Maximum Daily Load standards or would degrade the Total Maximum Daily Load classification of a water body, or would violate existing international, Federal, or state water discharge treaties or regulations would be considered significant. Actions that occur within and do not comply with a state wellhead protection area and its management practices, a state coastal zone management program, or any new ground water or surface water extraction system that would affect the water table or flow rates that has not been coordinated with the appropriate regulatory agency would be considered significant.

3.2 Affected Environment

The Affected Environment discussion describes the particular characteristics of each resource area[47] within nine terrestrial biomes, the BOA, and the Atmosphere, which represent the land, air (atmosphere), water, and space environments where proposed BMDS activities are reasonably foreseeable. Each contains distinct plant and animal groups and political boundaries.

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[47] Cultural resources, environmental justice, land use, socioeconomics, utilities and visual resources are not discussed in the biome descriptions because they are local in nature and are not analyzed in Chapter 4.

A biome is a large geographical area of distinctive plant and animal groups. The climate and geography of an area determine what type of biome can exist in that area. Major terrestrial biomes include deserts, forests, grasslands, mountains, tundra and associated surface water bodies. Major marine systems include intertidal zones (which include sandy beaches, rocks, estuaries, mangrove swamps and coral reefs), neritic zones (the relatively shallow ocean that extends to the edge of the continental shelf, where primary productivity depends on planktonic algae growing as deep as the light can reach), oceanic zones, and abyssal plains.

Detailed descriptions of the nine terrestrial biomes, the BOA, and the Atmosphere as addressed in this PEIS are found in Appendix H Biome Descriptions.

3.2.1 Arctic Tundra Biome

The Arctic Tundra Biome[48] discussion encompasses the arctic coastal regions that border the North Atlantic Ocean and Arctic Ocean. This biome includes coastal portions of the state of Alaska in the U.S., Canada, and Greenland (administered by Denmark). The global distribution of this biome is depicted in Exhibit 3-11.

The majority of the Arctic Tundra Biome is located north of the latitudinal tree line and consists of the northern continental fringes of North America from approximately the Arctic Circle northward. For example, Thule AFB, Greenland, which is located approximately 1,100 kilometers (700 miles) north of the Arctic Circle, is the northernmost installation where MDA activities for the proposed BMDS may occur. The Arctic Tundra Biome includes other coastal locations that may be situated south of the Arctic Circle but have a climate and ecosystem similar to that of inland Arctic Tundra. These sites are located on the islands of the Aleutian chain and include Eareckson Air Station, Shemya Island, Alaska, and Port of Adak, Adak, Alaska.

[48] Exhibit 3-11 shows the global location of the Arctic Tundra ecosystem. However, based on reasonably foreseeable locations for activities for the proposed BMDS to occur, the Affected Environment focuses on the coastal portions of this ecosystem.

Exhibit 3-11. Global Distribution of the Arctic Tundra Biome

Source: Modified from National Geographic, 2003a

3.2.1.1 Air Quality

The climate of the Arctic Tundra Biome is characterized as polar maritime with persistent overcast skies, high winds, frequent and often violent storms, and a narrow range of temperature fluctuation throughout the year. The average annual temperature is -28°Celsius (^{o}C) (-18°Fahrenheit [^{o}F]). Parts of the Arctic Tundra may be classified as desert due to low precipitation. Annual precipitation is light, often less than 200 millimeters (eight inches). Most precipitation falls as snow in October through November. However, because potential evaporation also is very low, the climate tends to be humid. The Arctic Tundra also is characterized by high winds, which can blow between 48 to 97 kilometers (30 to 60 miles) per hour.

Air quality in the Arctic Tundra Biome is considered good, however, some areas in and around urban centers are in non-attainment for CO.

3.2.1.2 Airspace

Airspace above U.S. military airfields in the Arctic Tundra Biome includes controlled airspace and operates under IFR. The Arctic Tundra Biome also includes regions that are located in international airspace and therefore, the procedures of the International Civil Aviation Organization (ICAO) are followed. Much of Alaska's aviation activity takes

place within existing MOAs, through a shared-use agreement, with information provided by the Special Use Airspace Information Service, which is a system operated by the U.S. Air Force under agreement with the FAA Alaskan Region to assist pilots with flight planning and situational awareness while operating in or around MOAs or Restricted Areas in interior Alaska. In Canada, the Air Navigation Services and Airspace Services of Transport Canada are responsible for issues involved with airspace utilization and classification, levels of service for Air Navigation Service facilities, and services, including weather, navigation, radar, and communication services. In Greenland, the Danish Civil Aviation Administration issues Notices to Airmen (NOTAMs) regarding restricted airspace.

Civilian, military, and private airports exist in the Arctic Tundra Biome. Civilian aircrafts generally fly along established flight corridors that operate under VFR.

3.2.1.3 Biological Resources

Tundra environments are characterized by treeless areas, which consist of dwarfed shrubs and miniature wildflowers adapted to a short growing season. Species resident in arctic tundra have evolved adaptations peculiar to high latitudes. Examples of land mammals found on the Arctic Tundra include shrews, hares, rodents, wolves, foxes, bears and deer. Several lakes in the Arctic Tundra region support a small, unique assemblage of freshwater fishes.

Wetlands are typical of the Arctic Tundra. Ecological reserves and wildlife refuges are found throughout the Arctic Tundra region. Disturbance caused by boats or aircraft usually is controlled by distance or altitude regulations in protected areas and advisory restrictions elsewhere. Sometimes boat activities, such as the use of horns, are restricted. Exhibit 3-12 gives distance/altitude restrictions currently in place in Arctic countries. Canada, Finland, Greenland, Russia, and the U.S. restrict the distance boats can approach breeding seabirds, but restrictions apply only to specific protected areas. Distance restrictions range from 15 meters (49 feet) for unmotorized boats in some reserves within Newfoundland, Canada, to 1,600 meters (5,250 feet) in reserves in the U.S.

Arctic countries restrict the altitude below which aircraft cannot fly over a seabird colony. In general, minimum altitudes are in the range of 300-500 meters (984 to 1,640 feet) but are higher over some reserves in the U.S. (700 meters [2,300 feet]). Canadian flight manuals advise a minimum altitude of over 600 meters (1,970 feet) when flying over bird concentrations. In Greenland, advisory rules are in place restricting disturbance to wildlife caused by mineral resource exploration and extraction (directed mainly at helicopters).

Exhibit 3-12. Regulated Activities Near Seabird Colonies in Arctic Regions

Country	Boat Distance (closest approach)	Boat Speed (maximum)	Aircraft Altitude (minimum)	Use of Boat Siren
Canada	20 meters (66 feet) – motorized[1] 15 meters (49 feet) – non-motorized 100 meters (328 feet) or 50 meters (164 feet) off murre colonies	--	300 meters (984 feet) April 1 – September 1 in Newfoundland province reserves, most large colonies are marked on aeronautical charts	Not explicitly restricted but not allowed if disturbance to colony occurs
Greenland	500 meters (1,640 feet) for some protected colonies	18 kilometers per hour (11 miles per hour)[2]	500 meters (1,640 feet)	--
U.S.	100 – 1,600 meters (328 – 5,250 feet)	--	500 – 700 meters (1,640 – 2,300 feet)	--

Source: Modified from Chardine and Mendenhall, 2003
[1]Provincial regulation; Gull Island, Witless Bay- mixed Atlantic Puffin, Black-legged Kittiwake, Common Murre colony. Boat tour operators presently exempt.
[2]Restriction in place for mineral exploration activities only

3.2.1.4 Geology and Soils

Under a protective layer of sod, water in the soil melts in summer to produce a thick mud that sometimes flows downslope to create bulges, terraces, and lobes on hillsides. The freeze and thaw of water in the soil sorts out coarse particles, giving rise to such patterns in the ground as rings, polygons, and stripes made of stones. The coastal plains have numerous lakes of thermokarst origin, formed by melting ground water.

Soil particles in the Arctic Tundra derive almost entirely from mechanical breakup of rock, with little or no chemical alteration. Continual freezing and thawing of the soil have disintegrated its particles. In the Arctic Tundra, the soil is very low in nutrients and minerals, except where animal droppings fertilize the soil. (Bailey, 1995) Below the soil is the tundra's permafrost, a permanently frozen layer of earth. The majority of the Arctic Tundra Biome resides on a layer of permafrost.

Geologic hazards in the Arctic Tundra Biome include earthquakes, volcanic activity, and avalanches.

3.2.1.5 Hazardous Materials and Hazardous Waste

Installations where MDA activities for the proposed BMDS may occur may store and use large quantities of hazardous materials, including a variety of flammable and combustible liquids. Procedures that comply with applicable laws and regulations for managing hazardous materials are developed to establish standard operating procedures for the correct management and storage of hazardous materials at installations. Due to the extreme climate, special measures may be necessary for storage and handling of hazardous materials in arctic areas.

Wastes generated by facilities that may be used for the proposed BMDS include oils, fuels, antifreeze, paint, paint thinner and remover, photo chemicals, pesticides, aerosol canisters, batteries, used acetone, sulfuric acid, and sewage sludge. Procedures that comply with applicable laws and regulations are developed for managing hazardous wastes at sites where activities for the proposed BMDS may occur.

3.2.1.6 Health and Safety

All activities associated with the proposed BMDS would comply with Federal, state, and local laws and regulations applicable to worker and environmental health and safety. The MDA would take every reasonable precaution during the planning and execution of the operations, training exercises, and test and development activities to prevent injury to human life or property. Health and safety procedures should be included in site-specific operating documents.

3.2.1.7 Noise

The principal sources of noise from missile defense operations are vehicular traffic and military activities, including aircraft operations, rocket testing, and rocket launches. Frequency and duration of noise from military activities vary as a factor of the irregular training schedules, and noise levels vary with the type of activities at these facilities. Sonic booms may be produced as a result of BMDS activities. Other sources of noise would result from construction activities. Measurements of ambient sound levels should be analyzed in site-specific environmental documents.

3.2.1.8 Transportation

Roadway travel in the Arctic Tundra Biome is generally limited due to the lack of roads in the vast, undeveloped terrain. The summer months experience the highest amount of traffic, due to tourism and good weather. The Arctic Tundra Biome includes railway systems that provide freight, passenger, and intermodal transportation across North America, as well as regional and local service railways. Given the vast area of the Arctic Tundra Biome and the limited road network, aircraft provide an alternate means of

transportation. Marine travel tends to be limited in the Arctic Tundra Biome due to glacial patches found throughout many waterways.

3.2.1.9 Water Resources

In the Arctic Tundra, alluvial deposits are the principal aquifers for ground water, which is greatly restricted by permafrost. During the summer when snow melts, the water percolates through the active layer but is unable to penetrate the permafrost. Pools of water form on the surface, and the active layer becomes saturated. Surface waters in the Arctic Tundra tend to be acidic and rich in organic material.

Surface water and ground water quality is generally good in the Arctic Tundra Biome except in isolated areas of known contamination. Although soils in the Arctic Tundra Biome are strongly acidic, pH of regional surface waters in North America is around 7, ranging from 6.8 to 7.5 in streams and 7.1 to 7.3 in lakes. The relatively high pH and capacity of streams and lakes to buffer acid inputs from natural and man-made sources are presumed to be the result of ions (e.g., calcium and magnesium) that have been carried into the atmosphere with sea spray and subsequently returned in rainfall. This is a common occurrence in coastal maritime regions. (Wetzel 1975, as referenced in FAA, 1996)

3.2.2 Sub-Arctic Taiga Biome

The Sub-Arctic Taiga Biome discussion focuses on the sub-arctic regions of North America, including portions of the state of Alaska. This biome is generally located between latitudes 50 and 60 degrees north (see Exhibit 3-13). The sub-arctic climate zone coincides with a great belt of needleleaf forest, often referred to as boreal forest, and with the open lichen woodland known as taiga. Existing inland sites found in Alaska in the Sub-Arctic Taiga Biome include Fort Greely (which includes Delta Junction), Clear Air Force Station, Eielson AFB, and Poker Flat Research Range.

Exhibit 3-13. Global Distribution of the Sub-Arctic Taiga Biome

Source: Modified From National Geographic, 2003b

Coastal sites also are located in the Sub-Arctic Taiga Biome, including portions of southwestern and western Alaska. Coastal sites are influenced by the cool climate generated by the cold waters of the North Atlantic Ocean and share maritime characteristics. Existing coastal sites where proposed BMDS activities may occur are found in Alaska in the Sub-Arctic Taiga Biome and include the KLC and the Port of Valdez.

3.2.2.1 Air Quality

The average temperature is below freezing for six months out of the year. Winter is the dominant season and the temperature range is -54^{o}C to -1°C (-65°F to 30°F). Summers are mostly rainy, and humid, and temperatures range from –7°C to 21°C (20°F to 70°F). The total precipitation in a year is 30 to 85 centimeters (12 to 33 inches), which may fall as rain or snow or accumulate as dew. Surface winds along the coast are much stronger and more persistent than at inland areas.

Air quality in the Sub-Arctic Taiga Biome generally is considered favorable; however, some areas in and around urban centers, such as Anchorage and Fairbanks are in non-attainment for CO concentrations. These urban centers typically exceed CO NAAQS only during the winter (October through March).

Emissions from activities for the proposed BMDS include CO, NO_X, SO_X, VOCs, HAPs, and PM. In coastal areas, wind-blown volcanic dust is the primary air contaminant.

3.2.2.2 Airspace

Airspace above U.S. military airfields in the Sub-Arctic Taiga Biome generally includes controlled airspace and operates under IFR.

Much of Alaska's aviation activity takes place within existing MOAs, through a shared-use agreement, with information provided by the Special Use Airspace Information Service, which is a system operated by the U.S. Air Force under agreement with the FAA Alaskan Region to assist pilots with flight planning and situational awareness while operating in or around MOAs or Restricted Areas in interior Alaska.

There are approximately 600 civilian, military, and private airports and more than 3,000 airstrips in the state of Alaska. Existing military airfields, with runways that are paved and in good condition, would be used to support activities for the proposed BMDS.

Civilian aircraft generally fly along established flight corridors that operate under VFR.

3.2.2.3 Biological Resources

The vegetation of the Sub-Arctic Taiga Biome is primarily boreal forest, which is a complex array of plant communities shaped by fire, soil temperature, drainage, and exposure.

The interior areas of the Sub-Arctic Taiga Biome are populated with many animals that have evolved to meet conditions found at higher latitudes. All estuarine and marine areas out to the exclusive economic zone (322 kilometers [200 miles] from the coast) of the U.S. used by Alaskan Pacific salmon are designated as Essential Fish Habitat for salmon fisheries. Essential Fish Habitat also has been designated for scallops and Gulf of Alaska ground fish in the Port of Valdez. (U.S. Army Space and Missile Defense Command, 2003)

Most wetlands in the Sub-Arctic Taiga generally are classified as palustrine (non-flowing) or riverine, which occur alongside rivers and streams. On most wetlands in the sub-arctic region, wet soils result from a variety of sources, including the late melt of snow over either impervious subsoil layers such as glacial silts or discontinuous permafrost.

3.2.2.4 Geology and Soils

High mountains, broad lowlands, diverse streams and lakes, and complex rock formations characterize the geology of the Sub-Arctic Taiga Biome.

The boreal forest grows on poorly developed soils with pockets of wet, organic histosols. These light gray soils are wet, strongly leached, and acidic; they form a highly distinct layer beneath a topsoil layer of organic matter. Soils in the coastal areas are typically rocky, organic, or volcanic. The maritime taiga is characterized by poor drainage of surface water.

Geologic hazards in the Sub-Arctic Taiga Biome include earthquakes, volcanic activity, and avalanches.

3.2.2.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste in the Sub-Arctic Taiga Biome are similar to those found in the Arctic Tundra Biome described in Section 3.2.1.5.

3.2.2.6 Health and Safety

Health and Safety attributes of the Sub-Arctic Taiga Biome are similar to those discussed in Section 3.2.1.6.

3.2.2.7 Noise

The Sub-Arctic Taiga Biome generally is sparsely populated and most of the region is expected to have a background noise level of DNL less than or equal to 55 dBA.

3.2.2.8 Transportation

Transportation attributes of the Sub-Arctic Taiga Biome are similar to those discussed in Section 3.2.1.8.

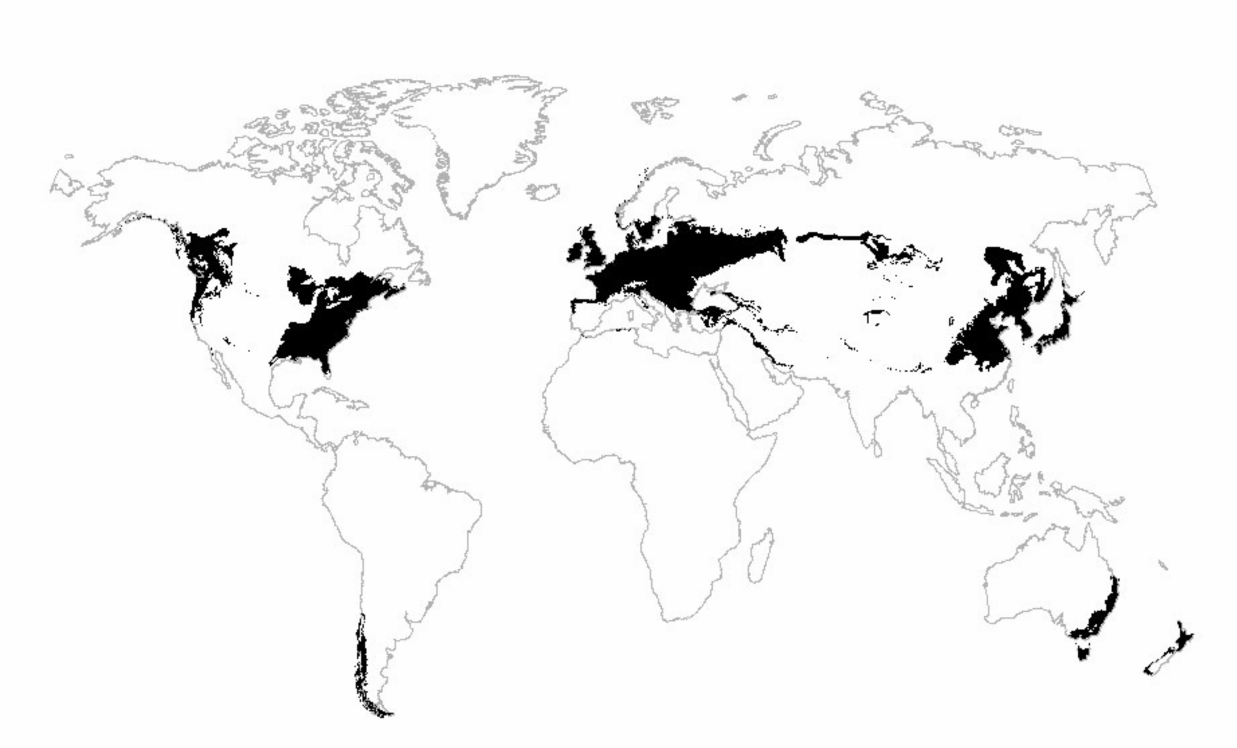
3.2.2.9 Water Resources

Ground water is supplied by rivers, precipitation, and melt water in the Sub-Arctic Taiga Biome. Characteristic of the taiga are innumerable water bodies, including bogs, fens, marshes, shallow lakes, rivers and wetlands, which are intermixed among the forest and hold vast amounts of water. In coastal areas, ground water is found primarily in river basins and recharged by infiltration of melt water from precipitation and glaciers. Water quality is subject to seasonal variations, but remains within established EPA drinking water standards.

3.2.3 Deciduous Forest Biome

As shown in Exhibit 3-14, the Deciduous Forest Biome includes the deciduous forest regions of North America, which include most of the eastern portion of the U.S. and parts of central Europe and East Asia. The description in this section of the U.S. deciduous forest is representative of this biome throughout the world.

Exhibit 3-14. Global Distribution of the Deciduous Forest Biome



Source: Modified From National Geographic, 2003b

Existing inland sites in the Deciduous Forest Biome include Redstone Arsenal, Alabama; Fort Devens, Massachusetts; and Aberdeen Proving Ground, Maryland.

Coastal sites also are located in the Deciduous Forest Biome. These sites share maritime characteristics. Existing coastal sites include Naval Air Station Patuxent River, Maryland; Wallops Island, Virginia; Cape Canaveral Air Force Station, Florida; Cape Cod Air Force Station, Massachusetts; and Eglin AFB, Florida.

3.2.3.1 Air Quality

The average annual temperature in a deciduous forest is 10°C (50°F). The average rainfall is 76 to 152 centimeters (30 to 60 inches) a year, with nearly 36 centimeters (14 inches) of rain in the winter and more than 46 centimeters (18 inches) of rain in the

summer. Humidity in these forests is high, ranging from 60 to 80 percent. Because of its location, air masses from both the cold polar region and the warm tropical region contribute to the climate changes in this biome.

Many metropolitan regions on the U.S. Atlantic Coast are in non-attainment for EPA's NAAQS for ozone, the primary constituent of urban smog. The southern Atlantic coast from Virginia through Florida is in attainment for all criteria air pollutants. However, the entire coastal area from northern Virginia through Maine is in non-attainment for ozone (ranging from moderate to severe), and small areas in Connecticut are in moderate non-attainment for PM_{10}.

Emissions from activities for the proposed BMDS include CO, NO_X, SO_X, VOCs, HAPs, and PM. Existing emissions sources in the coastal areas of the Deciduous Forest Biome are primarily the same as for those in the inland areas.

3.2.3.2 Airspace

The Deciduous Forest Biome in the U.S. contains all FAA classifications for airspace, as described in Section 3.1.2.

3.2.3.3 Biological Resources

On numerous sites where activities for the proposed BMDS may occur, native vegetation has been removed, and the land is landscaped and maintained by mowing and brush control measures. Isolated pockets of vegetation may remain on sites where activities for the proposed BMDS may occur, however, vegetation on off-site areas is widespread and may be undisturbed.

The Deciduous Forest Biome provides habitat for a wide variety of animals. State and federally endangered and threatened species in the biome include but are not limited to red-cockaded woodpeckers and the northeastern tiger beetle.

The Florida Keys have been designated a National Marine Sanctuary, Outstanding Florida Waters, and an Area of Critical State Concern. In addition, the Deciduous Forest Biome includes critical habitat. For example, critical habitat for the Northern Right whale (*Eubalaena glacialis*) is designated for portions of Cape Cod Bay and Stellwagen Bank, the Great South Channel (each off the coast of Massachusetts) and waters adjacent to the coasts of Georgia and the east coast of Florida.

3.2.3.4 Geology and Soils

The geology of the Deciduous Forest inland is varied and consists of low mountains and plateaus. The Coastal Plain is predominantly flat and is covered with terrestrial sediments.

There are two types of soil found in deciduous forests in the U.S. Fertile soils with high organic content are rich in nutrients and have well-developed layers of clay. The second type, the “red clay” soils are found in humid temperate and tropical areas of the world, typically on older, stable landscapes. In coastal areas of this biome, soils are predominantly deep and adequately drained.

Because limited seismic activity occurs along the Atlantic continental shelf, the risk of an earthquake in the Deciduous Forest Biome is low. Volcanic activity generally is not observed along the U.S. Atlantic and Gulf Coasts, however, cracks present in the Eastern Seaboard have the potential to cause the seabed to crumble and create a tsunami that would push huge masses of sea water toward the coast. Landslides are a significant geologic hazard throughout the Deciduous Forest Biome.

3.2.3.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste attributes of the Deciduous Forest Biome are similar to those discussed in Section 3.2.1.5. Except the moderate climate characteristic of the Deciduous Forest Biome does not require special consideration as is necessary in the extreme temperatures of the Arctic Tundra Biome.

3.2.3.6 Health and Safety

Health and Safety attributes of the Deciduous Forest Biome are similar to those discussed in Section 3.2.1.6.

3.2.3.7 Noise

The Eastern Range is a representative example of noise levels for sites where activities for the proposed BMDS may occur in the Deciduous Forest Biome. Ambient noise levels based on daytime monitoring, range from 60 dBA to 80 dBA. (DOT, 2001) Noise sources associated with the proposed BMDS are similar to those described in Section 3.2.1.7.

3.2.3.8 Transportation

The Deciduous Forest Biome includes both coastal and inland regions that sustain widespread infrastructure, including marine ports and docks that are supported by traffic

circulation systems such as highways and byways, unpaved roads, non-maintained roads, trails, railroad lines, municipal, private, and military airports and any other system involved in mass transportation.

On-site roadways provide access to launch complexes, support facilities, and industrial areas. Railways transport both cargo and passengers in the region.

There are numerous commercial, private, and military airports within the Deciduous Forest Biome. They vary in size from major international airports such as Hartsfield-Jackson Atlanta International Airport in Georgia that supports 80 million passengers each year to small, rural airstrips that support single engine planes.

The top ports in U.S. foreign trade are deep draft (drafts of at least 12 meters [40 feet]). Twenty-five U.S. ports, located within the Deciduous Forest Coastal Biome, received 73 percent of total vessel calls. (DOT BTS, 2001)

3.2.3.9 Water Resources

Ground water provides about 40 percent of the U.S. public water supply. Where water demand is great, sophisticated reservoir, pipeline, and purification systems are needed to meet demands. Ground water resources along the coast are vulnerable to saltwater intrusion and nutrient contamination. (USGS, 2000)

Water quality in the Deciduous Forest Biome varies depending on pressures from human activity (e.g., industrial effluents and agricultural run-off). Pollution of coastal waters often results from runoff laden with particulates and other pollutants; sewage treatment plants; combined sewer overflows; and storm drains that discharge liquid waste directly into the ocean through pipelines, dumping of materials dredged from the bottoms of rivers and harbors, and waste from fish processing plants, legal and illegal dumping of wastes from ships and ground water from coastal areas.

3.2.4 Chaparral Biome

The Chaparral Biome includes regions corresponding to those shown in Exhibit 3-15, but focuses on a portion of the California Coast and the coastal region of the Mediterranean from the Alps to the Sahara Desert and from the Atlantic Ocean to the Caspian Sea. Representative sites where activities for the proposed BMDS may occur are part of the Western Range, including Vandenberg AFB and the Point Mugu Sea Range.

Exhibit 3-15. Global Distribution of the Chaparral Biome

Source: Modified From National Geographic, 2003b

3.2.4.1 Air Quality

The Chaparral climate consists of hot summer drought and winter rain in the mid-latitudes, north of the subtropical climate zone. The climate in this area is unique with the wet season occurring in winter and annual rainfall of only 38 to 102 centimeters (15 to 40 inches). Cold ocean currents and fog affect temperatures, which limit the growing season. The high-pressure belts of the subtropics drift northwards in the Northern Hemisphere from May to August and they coincide with substantially higher temperatures and little rainfall. During the winter, weather becomes dominated by the rain-bearing low-pressure depressions. While usually mild, such areas can experience cold snaps when exposed to the icy winds of the large continental interiors, where temperatures can drop to -40°C (-40^{o}F) in the extreme continental climates. (Atmosphere, Climate and Environment Programme, 2003)

The primary sources of air pollutants in coastal areas include stationary sources, area sources, mobile sources, and biogenic sources such as forest fires. VOCs react with sunlight in the atmosphere to produce ozone (i.e., smog). In some areas, background levels of air pollutants are relatively high due to air currents depositing pollution from sources outside of the coastal area.

There is a large area along the Pacific coast, particularly in southern California that is in non-attainment for ozone (ranging from severe to extreme). A large area in southern California is in severe non-attainment for PM_{10}. (EPA, 2003f) The EPA has designated the near shore areas of southern California as unclassified/attainment areas. Due to the lack of major emissions sources in the area and the presence of strong northeast winds, the likelihood of pollutants remaining in the ambient air is low.

Heavy industrial activities, high automobile traffic, and energy generation are the main sources of air pollutants along the southern Pacific coast.

The European Union eight-hour air quality standard for ozone (53 nmol/mol) is exceeded throughout the summer in the entire Mediterranean region.

3.2.4.2 Airspace

Airspace in coastal regions of North America contains "North American Coastal Routes," which are numerically coded routes preplanned over existing airways and route systems to and from specific coastal fixes. See Section 3.1.2 for a description of North American Routes.

Portions of the Chaparral Biome are located in international airspace. Therefore, the procedures of the ICAO (outlined in ICAO Document 444, Rules of the Air and Air Traffic Services) are followed.

There are numerous restricted areas in the near shore environment associated with the Western Range. The procedures for scheduling each portion of airspace are performed in accordance with letters of agreement with the controlling FAA facility, Los Angeles Air Route Traffic Control Center (ARTCC).

Numerous airports and airfields exist within the Chaparral Biome. Numerous jet routes that cross the Pacific pass through the U.S. Chaparral Biome, including A331, A332, A450, R463, R465, R584, Corridor V506 and Corridor G10.

3.2.4.3 Biological Resources

The vegetation of the Chaparral is characterized by the presence of hard, tough, evergreen leaves and low, shrubby appearance.

Birds of the Chaparral include the endangered California gnatcatcher (*Polioptila californica*), California thrasher (*Toxostoma redivivum*), western scrub jay (*Aphelocoma californica*), and cactus wren (*Campylorhynchus brunneicapillus*).

The near shore and coastal environment of the Chaparral Biome support numerous threatened or endangered species.

The Chaparral Biomes around the world support 20 percent of all plants, but these areas are all relatively small and many are threatened. Essential Fish Habitat includes those waters and sediment that are necessary to complete the life cycle for fish from spawning to maturity. There are two Essential Fish Habitat zones in this region, coastal pelagic and groundfish.

3.2.4.4 Geology and Soils

The California Coastal Chaparral area consists of narrow ranges with wide plains in between, as well as alluviated lowlands and coastal terraces.

The soils of the Chaparral Biome may be classified into four categories, coastal beach sands, tidal flats, loamy sands, and silty clay. The erosion hazard of these soils depends on slope and vegetation cover.

The California Chaparral Coastal area is noted for its intense seismic activity due to the right lateral motion of the Pacific and North Atlantic Plate boundary.

3.2.4.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste attributes of the Chaparral Biome are similar to those discussed in Section 3.2.1.5. Except the moderate climate characteristic of the Chaparral Biome does not require special consideration as is necessary in the extreme temperatures of the Arctic Tundra Biome.

3.2.4.6 Health and Safety

Health and Safety attributes of the Chaparral Biome are similar to those discussed in Section 3.2.1.6.

3.2.4.7 Noise

Vandenberg AFB is a representative example of noise levels for sites where activities for the proposed BMDS may occur in the Chaparral Biome. Ambient noise levels at Vandenberg AFB range from 48 dBA to 67 dBA. (DOT, 2001) Noise sources associated with the proposed BMDS are described in Section 3.2.1.7.

3.2.4.8 Transportation

Transportation attributes of the Chaparral Biome are similar to those discussed in Section 3.2.3.8.

3.2.4.9 Water Resources

Very few perennial streams occur in the Southern California coastal area. There is relative scarcity, on a per capita basis, of freshwater supplies in Mediterranean regions, where agriculture competes for freshwater with growing tourism and industrial use. (UNEP Plan Bleu, 2000)

Water quality attributes of the Chaparral Biome are similar to those described in Section 3.2.3.9.

3.2.5 Grasslands Biome

As shown in Exhibit 3-16, the Grasslands Biome includes the grasslands of North and South America, Eurasia, and Australia. The description in this section is representative of this biome throughout the world. Currently there are no active sites in the Grassland Biome where activities for the BMDS are proposed to occur. However, past military installations within this biome make it reasonable foreseeable that future activity proposed for the BMDS could occur there. There are no reasonably foreseeable coastal sites located in the Grasslands Biome.

Exhibit 3-16. Global Distribution of the Grasslands Biome

Source: Modified From National Geographic, 2003b

3.2.5.1 Air Quality

In the Grasslands Biome, approximately 25 to 76 centimeters (10 to 30 inches) of precipitation falls annually. The temperature varies due to the vast latitudinal span of the grasslands, with annual temperatures ranging from -20ºC to 43°C (-4ºF to 104°F). The average annual temperature across the Grasslands Biome is 24°C (43°F). The low humidity of the Grasslands Biome arises because mountain barriers block warm, moist air from oceans.

Air pollution issues of special concern to the Grasslands Biome are emissions from open burning and fugitive dust.

Due to the low population density of most grassland areas, biogenic (naturally occurring) activities are the predominant sources of air pollution emissions in this biome.

3.2.5.2 Airspace

The U.S. Grassland Biome contains all FAA airspace classifications, as described in Section 3.1.2.

3.2.5.3 Biological Resources

Short grasses, which are predominant throughout the Grasslands Biome, have adapted physiological responses to widespread drought and fire.

Naturally occurring grasslands are becoming harder to find due to human encroachment that can be attributed to increasing population pressures, desire for farmland, and oil exploration, among others. Biological resources of particular concern in the biome are migrating waterfowl and ephemeral prairie potholes.

3.2.5.4 Geology and Soils

The predominant soil type found throughout the Grasslands Biome is characterized by a thick, dark surface horizon resulting from the long-term addition of organic matter derived from plant roots.

There are no significant geological hazards within the Grasslands Biome.

3.2.5.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste attributes of the Grasslands Biome are similar to those discussed in Section 3.2.1.5, except that the moderate climate characteristic of

the Grassland Biome does not require special consideration as is necessary in the extreme temperatures of the Arctic Tundra Biome.

3.2.5.6 Health and Safety

Health and Safety attributes of the Grasslands Biome are similar to those discussed in Section 3.2.1.6.

3.2.5.7 Noise

Noise sources associated with the proposed BMDS are similar to those described in Section 3.2.1.7.

3.2.5.8 Transportation

Railroads and motor carriage (i.e., trucking) are the backbone of the freight transportation system in the Grasslands region. The highway system in the prairies consists largely of rural roads, many of which are local roads that are maintained by county and township governments.

3.2.5.9 Water Resources

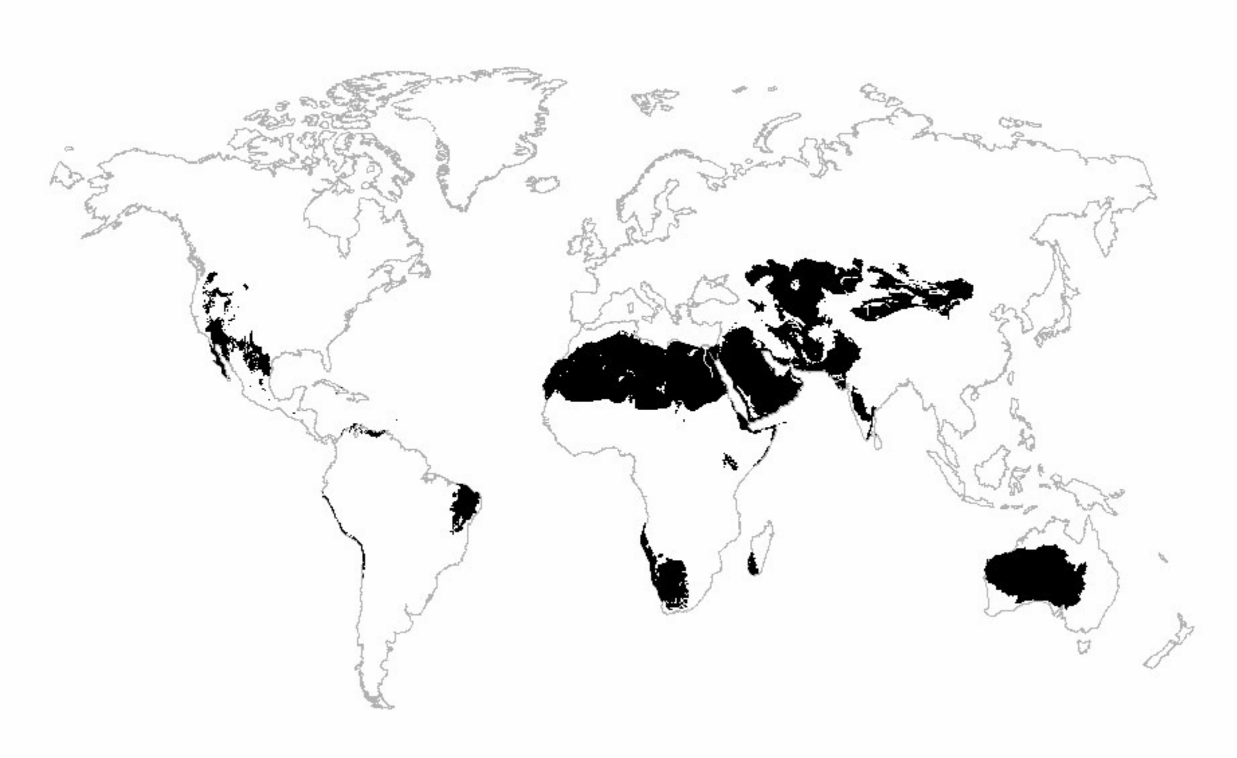
Sources of water in the Grasslands Biome include precipitation, ground water in aquifers, and surface water in rivers, streams, lakes, and wetlands. Due to the heavy dependence on underground water systems for irrigation of the plains' extensive farmland (and to a lesser extent for municipal water systems and industrial development), the depletion of the Grassland Biome's aquifers is of special concern.

The quality of water in the High Plains aquifer generally is suitable for irrigation use, but in many places, the water does not meet EPA drinking water standards with respect to several dissolved constituents: dissolved solids/salinity, fluoride, chloride, and sulfate. (USGS, 2003)

3.2.6 Desert Biome

The Desert Biome includes the desert regions of North America, which include the western arid environment of the southwestern U.S. (See Exhibit 3-17) The description in this section of the U.S. desert is representative of this biome throughout the world. Existing inland sites in the Desert Biome include WSMR, New Mexico; Fort Bliss, Texas; Edwards AFB, California; and the Nevada Test Site, Nevada.

Exhibit 3-17. Global Distribution of the Desert Biome



Source: Modified From National Geographic, 2003b

3.2.6.1 Air Quality

In cold desert regions, temperatures range from 2ºC to 4ºC (36ºF to 39ºF) in the winter and from 21ºC to 26ºC (70ºF to 79ºF) in the summer. Total annual precipitation averages 15 to 26 centimeters (six to ten inches). In contrast, hot desert regions have average monthly temperatures above 18ºC (64ºF), with typical temperatures ranging from 20^{o}C to 25ºC (68^{o}F to 77ºF). Hot desert regions usually have very little precipitation annually and/or concentrated precipitation in short periods, totaling less than 15 centimeters (six inches) per year.

A unique pollutant of concern in desert regions is dust, i.e., PM, which contributes to desertification, the process of creating deserts. Activities that expose and disrupt topsoil, such as grazing and agricultural cultivation common throughout the western U.S., can increase the amount of dust released into the air.

The predominant source of air pollution in the Desert Biome is agriculture, which disturbs the surface layer soil and emits dust into the air.

3.2.6.2 Airspace

The U.S. Desert Biome contains all FAA classifications for airspace, as described in Section 3.1.2.

3.2.6.3 Biological Resources

The Desert Biome encompasses three major vegetation types: semi-desert grassland, plains-mesa sand scrub, and desert scrub.

Desert animals include small nocturnal carnivores, insects, arachnids, reptiles, and birds.

3.2.6.4 Geology and Soils

Nearly 50 percent of desert surfaces are plains where the removal of fine-grained material by wind has exposed loose gravels consisting predominantly of pebbles and occasional cobbles, forming "desert pavement." The remaining surfaces of the Desert Biome are composed of exposed bedrock outcrops, desert soils, and fluvial deposits, including alluvial fans (a cone-shaped deposit of sediments), playas (dry lake beds), desert lakes, and oases. Bedrock outcrops commonly occur as small mountains surrounded by extensive erosional plains.

Desert soils are predominately mineral soils with low organic content. Poorly drained areas may develop saline soils and dry lakebeds may be covered with salt deposits. Geologic hazards within the Desert Biome include earthquakes and landslides.

3.2.6.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste attributes of the Desert Biome are similar to those discussed in Section 3.2.1.5.

3.2.6.6 Health and Safety

Health and Safety attributes of the Desert Biome are similar to those discussed in Section 3.2.1.6.

3.2.6.7 Noise

Ambient noise levels for remote desert environments range from 22 to 38 dBA. Ambient noise levels at a representative site where activities for the proposed BMDS may occur within the Desert Biome range from 65 dBA to 85 dBA at Edwards AFB and from 45 dBA to 65 dBA at WSMR. (DOT, 2001) Noise sources associated with the proposed BMDS are described in Section 3.2.1.7.

3.2.6.8 Transportation

Because the population density is so low and dispersed throughout most of the region, transportation infrastructure is concentrated near metropolitan centers.

3.2.6.9 Water Resources

In the Desert Biome, droughts and aquifer supply issues are of particular concern. The leading causes of impairment of rivers and streams include pathogens (bacteria), siltation (sedimentation), and habitat alterations, and the leading sources for these include agriculture, hydraulic modifications, and habitat modifications.

3.2.7 Tropical Biome

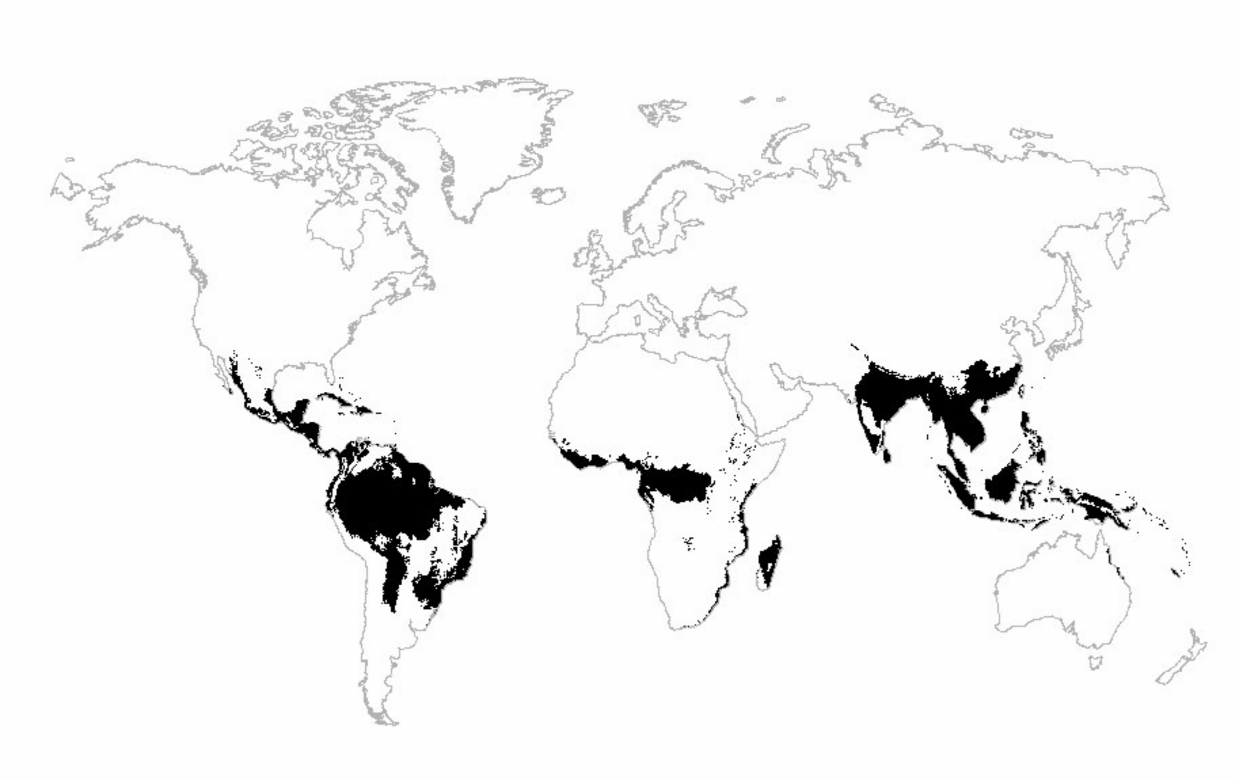
The Tropical Biome[49] encompasses areas within the Pacific and Atlantic Oceans. (See Exhibit 3-18) The coastal zone stretches 1,000 meters (3,281 feet) inland of the coastal shoreline, tidal wetlands, coastal wetlands, and coastal estuaries. (Coastal Planning Coalition of Australia, 2003) Because many of the islands within the Pacific and Atlantic Oceans are relatively small, the entire island may be considered within this Affected Environment section.

The Pacific Tropical Biome would include islands found within the equatorial region. The Pacific contains approximately 25,000 islands, the majority of which are found south of the equator. (Wikipedia, 2003) Current Ranges within this biome where activities of the proposed BMDS may occur include PMRF, U.S. Army Kwajalein Atoll (USAKA), Wake Island, and Midway.

The majority of islands in the Atlantic Tropical Biome are in the Caribbean between the Caribbean Sea and the North Atlantic Ocean.

[49] Exhibit 3-18 shows the global location of the Tropical ecosystem. However, based on reasonably foreseeable locations for activities for the proposed BMDS to occur, the affected environment focuses on the coastal portions of this ecosystem.

Exhibit 3-18. Global Distribution of the Tropical Biome



Source: Modified From National Geographic, 2003b

3.2.7.1 Air Quality

The climate for the Tropical Biome is tropical marine to semi-tropical marine, characterized by relatively high annual rainfall and warm to hot, humid weather throughout the year. Steadily blowing trade winds allow for relatively constant temperatures of 21°C to 27°C (70°F to 81°F) throughout the year. The annual rainfall in the Tropical Biome is approximately 127 to 1,016 centimeters (50 to 400 inches).

Ambient air quality monitoring data are not readily available for islands in the Pacific. In the Caribbean, and Latin America generally, increasing urbanization and rampant forest destruction have led to considerable air quality degradation.

Because of the relatively small numbers and types of air pollution sources, dispersion caused by trade winds, and lack of topographic features at most locations, air quality in the equatorial region is considered good (i.e., well below the maximum pollution levels established for air quality in the U.S.). (U.S. Army Space and Missile Defense Command, 2003)

3.2.7.2 Airspace

The majority of islands in the Pacific Tropical Coastal region are located in international airspace and therefore, the procedures of the ICAO are followed. The Atlantic Pacific Coastal region consists of both U.S. and international airspace.

The procedures for scheduling each portion of airspace are performed in accordance with letters of agreement with the controlling FAA facility.

There are numerous Range-affiliated airport and airfields located within the Pacific Tropical Coastal Affected Environment, including Wake Island, USAKA, PMRF, and Midway. Many of these airfields are engaged in activities similar to those of the proposed activities. Future test events would act in accordance with existing activities at the airfields. The majority of local airports within the Atlantic Tropical Coastal region handle smaller, private aircraft, which are uncontrolled.

High-altitude overseas jet routes cross the Pacific Tropical Coastal region via nine Control Area Extension corridors off the California coast.

3.2.7.3 Biological Resources

Vegetation and wildlife in the Tropical Biome is among the most biologically diverse in the world.

There are numerous environmentally sensitive habitats within the Tropical Biome, including barrier reefs, whale sanctuaries, and fisheries.

3.2.7.4 Geology and Soils

Islands within the Pacific Tropical Biome range from atolls with small, low inlets and extensive lagoons, to raised limestone islands, to volcanic high islands with substantial topographic and internal climatic diversity. Coral reefs have developed upon the eroded platforms around some of the islands.

Islands within the Atlantic Tropical Biome are composed of two distinctive chains of islands, the Lesser and Greater Antilles. The islands are characterized by a range of geological formations, from volcanic and sedimentary strata to coral limestone and alluvium.

The soils on smaller atolls in the Pacific Ocean have low fertility due to alkalinity. The soils are permeable, and infiltration is rapid. Wind erosion is severe when vegetation has been removed.

The islands within the Atlantic Tropical Biome include a wide range of soils, which may be derived from limestone, serpentine, dolomite, basalt, granite, diorite, gabbro, sandstone, or slate.

Volcanic islands within the Pacific Ocean have been built of successive lava flows. Volcano eruptions occur relatively frequently on the islands. (NOAA, 2003b)

In the Atlantic region, many earthquakes and tsunamis have occurred in the northeastern Caribbean, where the movements of the Earth's surface plates are rapid and complicated. (USGS, 2001) Volcanoes erupt on the eastern and western sides of the Caribbean plate.

3.2.7.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste attributes of the Tropical Biome are similar to those discussed in Section 3.2.1.5. However, the moderate climate characteristic of the Desert Biome does not require consideration as is necessary in the extreme temperature of the Arctic Tundra Biome.

3.2.7.6 Health and Safety

Health and Safety attributes of the Tropical Biome are similar to those discussed in Section 3.2.1.6.

3.2.7.7 Noise

Natural background sound levels in the Tropical Biome are relatively high due to wind and surf. Sources of noise in the Tropical Biome are similar to principle sources of noise associated with sites where activities for the proposed BMDS may occur, as described in the Section 3.2.1.7.

3.2.7.8 Transportation

The smaller islands may require marine transport vessels to transport passengers and supplies between islands. The isolated locations of the equatorial environments make transportation vital to many of the locations. Ground transportation facilities consist of roadways and pathways used by motor vehicles, bicycles, and pedestrians. Ships and smaller craft carry ocean cargo and fuel to the Equatorial Islands and deliver workers and cargo, including fuel, between islands.

3.2.7.9 Water Resources

Seasonal rainfall is the primary source of freshwater for most small islands. Catchments are used to capture rainfall for potable use. Raw water is stored in aboveground storage

tanks. Coastal areas of the Caribbean near major watersheds often contain large lagoons of fresh or brackish water.

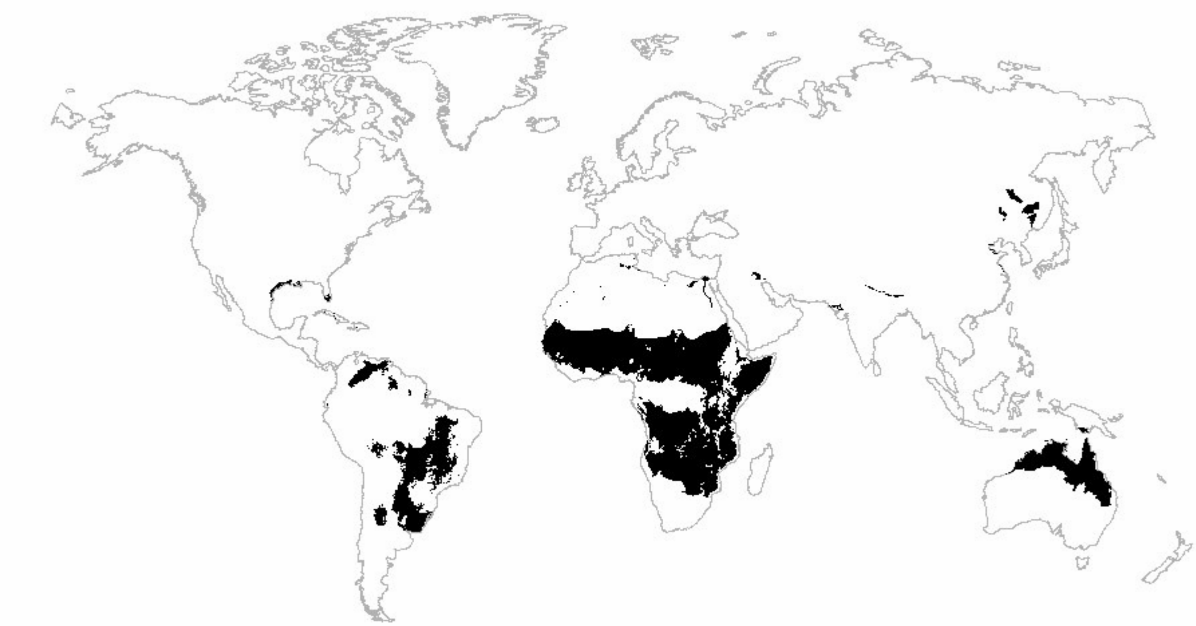
Of the land-based sources of pollution, eutrophication, or nutrient enrichment, from human sewage disposal is a growing problem in the Caribbean, particularly in the vicinity of large coastal cities and harbors.

Pacific Island water quality is generally of very high, with high dissolved oxygen and pH at levels typical of mid-oceanic conditions.

3.2.8 Savanna Biome

The Savanna Biome includes the transitional zone between the tropical forest and the semi-desert scrub vegetation types and typically occupies latitudes between 5º and 20º North and South of the equator (see Exhibit 3-19). Savannas cover extensive areas in the tropics and subtropics of Central and South America, Central and South Africa, and northern Australia in both inland and coastal environments. Currently there are not sites in the Savanna Biome where activities are proposed for the BMDS; however, it is reasonably foreseeable that future activity for the BMDS could occur here. The description in this section is representative of this biome throughout the world.

Exhibit 3-19. Global Distribution of the Savanna Biome



Source: Modified From National Geographic, 2003b

3.2.8.1 Air Quality

Towards the equator, annual rainfall is typically higher relative to the more poleward edges of the Savanna belt, and total annual precipitation may be as high as 250 centimeters (98 inches). On the Savanna edges nearest the tropics (towards the poles), annual rainfall totals may be as little as 50 centimeters (20 inches). In Australian savanna environments, coastal areas receive twice as much rainfall as inland savannas.

Annual temperatures in the Savanna Biome are relatively constant, averaging roughly 24ºC to 27ºC (75ºF to 80ºF).

The Savanna Biome faces similar air quality concerns as those found in the Grassland Biome, namely emissions from open burning, natural drought-driven fires, and other fugitive dust.

Fire is a predominant emission source, while anthropogenic activities, such as agriculture and mining also contribute.

3.2.8.2 Airspace

The Savanna Biome is located in international airspace; and therefore, the procedures of the ICAO are followed.

3.2.8.3 Biological Resources

Savannas are characterized by a continuous cover of perennial grasses, often one to two meters (three to six feet) tall at maturity. They also may have an open canopy of drought- or fire-resistant trees or an open shrub layer.

National parks and reserves have been established to preserve and protect threatened vegetative and wildlife species in the Savanna Biome. However, the parks are vastly under funded and often poorly managed.

3.2.8.4 Geology and Soils

Savannas typically have porous (often sandy) soil, with only a thin covering of nutrient-rich humus and an overall low concentration of nutrients.

Savannas are similar to grasslands in geologic and topographic features, predominantly characterized by flat terrain and may be marked with escarpments and other plateau-like features of sandstone or limestone composition. There are no significant geological hazards throughout the Savanna Biome.

3.2.8.5 Hazardous Materials and Hazardous Waste

There are no existing facilities proposed for use in the BMDS in the Savanna Biome. However, future sites would use hazardous materials similar to those in use at existing sites discussed in this chapter and would produce similar hazardous wastes.

Any future facilities that may be used as part of the proposed BMDS would adhere to all applicable legal requirements for hazardous materials and hazardous waste management as described in Section 3.1.7.

3.2.8.6 Health and Safety

Health and safety attributes of the Savanna Biome are similar to those discussed in Section 3.2.1.6.

3.2.8.7 Noise

Noise sources associated with the proposed BMDS in the Savanna Biome are similar to those described in Section 3.2.1.7.

3.2.8.8 Transportation

Transportation in the Savanna Biome is typically limited due to the frequently remote and rural nature of savannas. Highways, if present, are typically unpaved and may not be regularly maintained due to the low volume of traffic carried and remote locations. Railways are not a dominant form of transportation in the Savanna Biome.

Airports with paved runaways are scarce in the Savanna Biome.

Navigable waterways are present in some wetter savannas and may be used to transport goods to ports along coastal savannas.

3.2.8.9 Water Resources

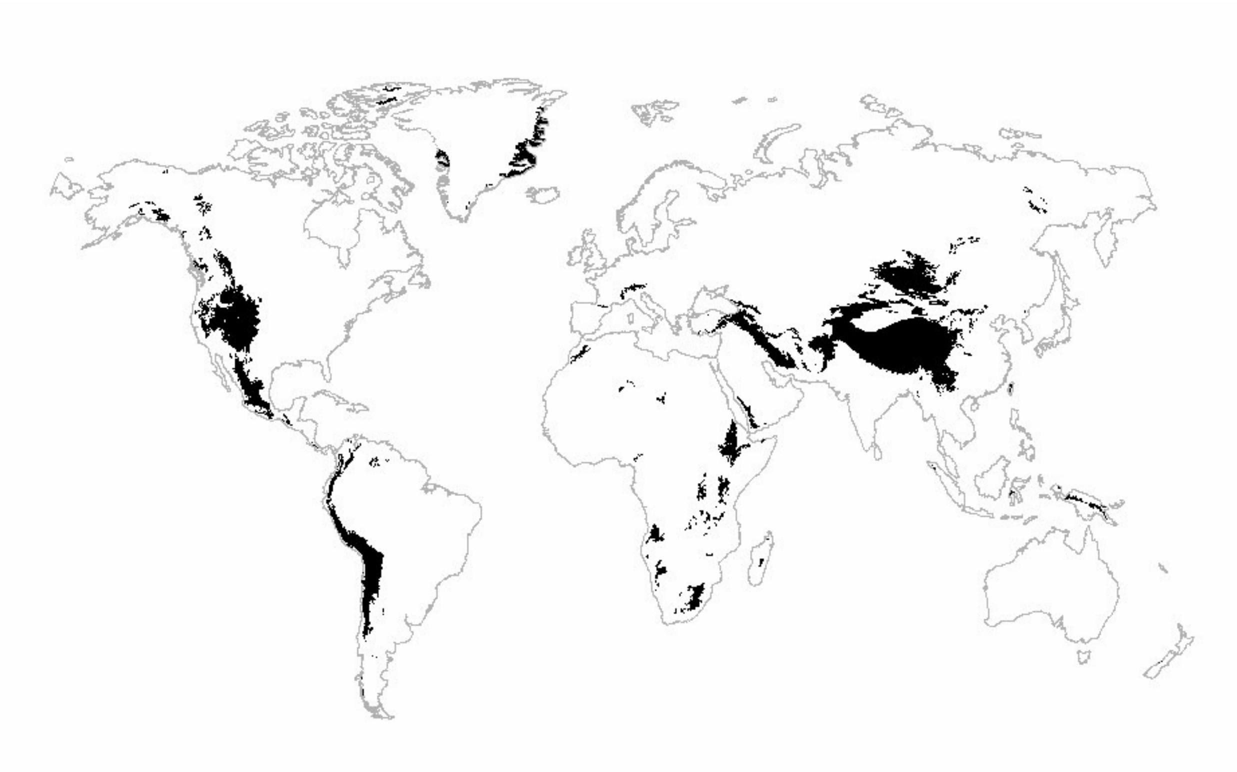
Savanna water resources are highly vulnerable to the effects of weed invasion, feral animals, overgrazing, and fire. Water resources are further strained by heavy water use in riparian areas for agriculture and tourism. (Douglas and Lukacs, 2004)

Water quality problems most commonly are caused by livestock and feral animals during the dry season.

3.2.9 Mountain Biome

As shown in Exhibit 3-20, the Mountain Biome includes the mountainous regions of North America and Europe, which include the Rocky Mountains in the western U.S. and the Alps in central Europe. The description in this section is representative of this biome throughout the world. Mountain Biomes are found at high altitudes and lie just below and above the snow line of a mountain. Existing inland sites in the Mountain Biome include Buckley AFB, Cheyenne Mountain AFB and Fort Carson Military Reserve, Colorado; and F.E. Warren AFB, Wyoming.

Exhibit 3-20. Global Distribution of the Mountain Biome



Source: Modified From National Geographic, 2003b

3.2.9.1 Air Quality

Given its high altitude, the Mountain Biome is characteristically cold with heavy snowfall and frequently bitter winds. Temperatures remain below freezing for at least seven months of the year, and in the summer, average temperatures range from 10°C to 15°C (50°F to 59°F). The average precipitation across mountain environments is 30 centimeters (12 inches) a year.

Mountain Biomes exhibit particular sensitivity to air pollution via deposition of both wet and dry pollutants, principally in snowpacks, which can in turn result in reduced surface water quality. Regional air pollutants of concern to mountainous areas include visibility-reducing PM, deposition of nitrogen and sulfur compounds, ozone, greenhouse gases that contribute to localized warming, and air toxics such as mercury and persistent organic pollutants.

Typical sources of air pollutants in the Mountain Biome include population centers, energy development and power plants, and agricultural activities.

3.2.9.2 Airspace

The U.S. Mountain Biome contains all FAA classifications for airspace, as described in Section 3.1.2.

3.2.9.3 Biological Resources

The high elevations of the mountain environments have harsh climatic conditions that support about 200 species of mountain plants.

Mountain animals have to tolerate cold temperatures and intense ultraviolet radiation. Because of the year-round cold, only warm-blooded animals can survive in the Mountain Biome, although insects also exist.

Some mammals within the Mountain Biome are considered sensitive species and may warrant special conservation measures, including critical habitat designation. Because food chains may be shorter in this biome than in more temperate biomes, food chains are more sensitive to environmental changes.

3.2.9.4 Geology and Soils

Much of the Mountain Biome appears as barren rock or a cover of thin soils. Soils in the biome are relatively fragile and are subject to erosion when disturbed.

The Mountain Biome is a complex network of mountain ranges characterized by extreme physiographic variability. Wide differences in elevation, slope steepness, and exposure exist locally and between major mountain masses.

Mountain Biomes are subject to numerous geological hazards, including earthquakes, landslides, and volcanoes.

3.2.9.5 Hazardous Materials and Hazardous Waste

Hazardous materials and hazardous waste attributes of the Mountain Biome are similar to those discussed in Section 3.2.1.5.

3.2.9.6 Health and Safety

Health and Safety attributes of the Mountain Biome are similar to those discussed in Section 3.2.1.6.

3.2.9.7 Noise

Sources of noise in the Mountain Biome are similar to principle sources of noise associated with sites where activities for the proposed BMDS may occur, as described in Section 3.2.1.7.

3.2.9.8 Transportation

The Mountain Biome sustains widespread infrastructure, including traffic circulation systems such as highways and byways, unpaved roads, non-maintained roads, trails, railroad lines, municipal, private, and military airports and any other system involved in mass transportation.

Due to the extreme cold and heavy snowfall characteristic of the Mountain Biome, airports within this region require the ability to provide landing access under zero visibility conditions such as blizzards and de-icing capability.

3.2.9.9 Water Resources

Surface water resources in the Mountain Biome include glacial lakes, streams, and rivers fed by rainfall and melting snow and those that originate from ground water sources. Mountain lakes are particularly sensitive to the effects of acidification because they have soft water, which does not neutralize acid readily.

In the Mountain Biome, elevated levels of contaminants accumulate in snowpacks, negatively impacting local flora and fauna. Upon melting, the concentrated pollutants are dispersed throughout the area watershed, deteriorating the quality of downstream surface and ground water systems. (USGS, 2003)

3.2.10 Broad Ocean Area

For purposes of this PEIS, the BOA encompasses the Pacific Ocean, the Atlantic Ocean, and the Indian Ocean.

Proposed activities in the BOA would take place at a distance of several hundred kilometers from any land mass. The BOA is subject to EO 12114, *Environmental Effects Abroad of Major Federal Actions,* which requires consideration of Federal actions abroad with the potential for impacts to the environment.

The Pacific Ocean is comprised of approximately 156 million square kilometers (60 million square miles) and includes the Bali Sea, Bering Sea, Bering Strait, Coral Sea, East China Sea, Flores Sea, Gulf of Alaska, Gulf of Tonkin, Java Sea, Philippine Sea, Savu Sea, Sea of Japan, Sea of Okhotsk, South China Sea, Tasman Sea, Timor Sea, and other tributary water bodies. Its maximum length is 14,500 kilometers (9,000 miles) and its greatest width is 17,700 kilometers (11,000 miles), which lies between the Isthmus of Panama and the Malay Peninsula. (Encyclopedia.com, 2003)

The Atlantic Ocean is comprised of approximately 76.8 million square kilometers (29.6 million square miles) and includes the Baltic Sea, Black Sea, Caribbean Sea, Davis Strait, Denmark Strait, part of the Drake Passage, Gulf of Mexico, Mediterranean Sea, North Sea, Norwegian Sea, almost all of the Scotia Sea, and other tributary water bodies. The Atlantic Ocean extends from the North Pole southward for about 16,100 kilometers (10,000 miles) to the Antarctic continent, and covers 106 million square kilometers (41 million square miles). The width of the Atlantic varies from approximately 2,850 kilometers (1,770 miles) between Brazil and Liberia to 4,830 kilometers (3,000 miles) between Norfolk, VA, and Gibraltar. The average depth is about 3,660 meters (12,000 feet) and the greatest depth is 8,650 meters (28,400 feet) in the Puerto Rico Trench. (Oceans of the World, 2003)

The Indian Ocean is comprised of about 68 million square kilometers (26 million square miles) and includes the Andaman Sea, Arabian Sea, Bay of Bengal, Great Australian Bight, Gulf of Aden, Gulf of Oman, Mozambique Channel, Persian Gulf, Red Sea, Strait of Malacca, Timor Sea, and other tributary water bodies. (CIA, 2003) It is triangular and bordered by Africa, Asia, Australia, and the Southern Ocean. Its maximum width is about 10,000 kilometers (6,200 miles) between the southernmost portions of Africa and Australia, and its average depth is approximately 4,000 meters (13,120 feet). The greatest depth occurs in the Java Trench at approximately 7,300 meters (24,000 feet) below sea level. (Oceans of the World, 2003)

3.2.10.1 Air Quality

No sources of ambient air quality monitoring data are known to exist for the BOA. There are no known existing emission sources in the Pacific Ocean. Air quality over the Pacific Ocean is expected to be good because there are no major sources of air pollution, and the nearly constant trade winds in the area serve to disperse any pollutants from transient sources, such as passing seagoing vessels or low-flying aircraft.

In the Atlantic Ocean, there is potential for large, thick plumes of aerosols blowing eastward over the North Atlantic. The aerosol plume is the regional haze produced by the industrial northeastern U.S. and typically occurs during the summer months. The haze is composed of sulfates and organics that originate from power plants and automotive sources. (NASA, 2003a) Ozone and other pollutants found in the Atlantic Ocean are primarily the result of anthropogenic sources.

A monitoring station in the Maldives Islands records air quality in the Indian Ocean. (Environmental News Network, 1999) The aerosol cloud covering much of the northern Indian Ocean originates primarily (at least 85 percent) from anthropogenic sources (Max Planck Society, 2001), namely agricultural and other biomass burning, the use of biofuels, and fossil fuel combustion in South and Southeast Asia. (Lelieveld et al., 2001) Model calculations indicate that, in contrast to European and North American pollution, anthropogenic emissions from South and East Asia reduce the concentration of hydroxyl (OH) radicals. Because OH is a powerful oxidant and acts as an atmospheric cleansing agent, the Asian pollution decreases the oxidizing power of the atmosphere, contributing to greater pollution problems over the Indian Ocean. (Max Planck Society, 2001)

Air quality over the Indian Ocean is seasonally poor due to anthropogenic emissions from growing South and Southeast Asian countries, particularly India. During the dry monsoon season (northern hemisphere winter), air pollutants in South and Southeast Asia are transported long distances to the Indian Ocean by persistent northeasterly monsoon winds. A dense, brown haze covers an area greater than 10 million square kilometers (3,900 million square miles) over most of the northern Indian Ocean (Max Planck Society, 2001), including the Arabian Sea, much of the Bay of Bengal, and part of the equatorial Indian Ocean to about five degrees south of the equator. (Environmental News Network, 1999) The haze extends from the ocean surface up to three kilometers (two miles). Comprised primarily of soot, sulfates, nitrates, organic particles, fly ash, and mineral dust, the airborne particles can reduce visibility over the BOA to less that 10 kilometers (6.2 miles) and reduce the solar heating of the ocean by about 15 percent. The haze also contains relatively high concentration of gases, including CO, SO_2, and other organic compounds. (Environmental News Network, 1999)

3.2.10.2 Airspace

Because the airspace in the BOA is beyond the territorial limit and is in international airspace, the procedures of the ICAO, outlined in ICAO Document 444, *Rules of the Air and Air Traffic Services* are followed. The FAA acts as the U.S. agent for aeronautical information to the ICAO.

Domestic Warning Areas are established in international airspace to contain activity that may be hazardous and to alert pilots of nonparticipating aircraft to the potential danger.

There are no airports or airfields located in the BOA.

High-altitude overseas jet routes cross the Pacific BOA via nine Control Area Extension corridors off the California coast.

3.2.10.3 Biological Resources

Marine biology of the open ocean consists of the animal and plant life that lives in and just above the surface waters of the sea and its fringes.

3.2.10.4 Geology and Soils

The Pacific Ocean floor of the central Pacific basin is relatively uniform, with a mean depth of about 4,270 meters (14,000 feet). (Oceans of the World, 2003) The Pacific Ocean is surrounded by a zone of violent volcanic and earthquake activity sometimes referred to as the "Pacific Ring of Fire." Icebergs are common in the Davis Strait, Denmark Strait, and the northwestern Atlantic Ocean from February to August and have been spotted as far south as Bermuda and the Madeira Islands. (Oceans of the World, 2003)

The principal feature of the bottom topography of the Atlantic BOA is a great submarine mountain range called the Mid-Atlantic Ridge. It extends from Iceland in the north to approximately 58 degrees south latitude, reaching a maximum width of about 1,600 kilometers (1,000 miles).

The Mid-Ocean Ridge dominates the terrain of the Indian Ocean floor. The Indian Ocean is subdivided by the Southeast Indian Ocean Ridge, Southwest Indian Ocean Ridge, and the Ninetyeast Ridge. (CIA, 2003)

Ocean sediments are composed of terrestrial, pelagic (open sea), and authigenic (grows in place with a rock) material. Terrestrial deposits consist of sand, mud, and rock particles formed by erosion, weathering, and volcanic activity on land and then washed to sea. (Wikipedia, 2003) Occasional icebergs occur in the southern reaches of the Indian Ocean. (CIA, 2003)

3.2.10.5 Hazardous Materials and Hazardous Waste

For test events using sea-based platforms, hazardous materials would be handled and used in accordance with all applicable state and Federal regulations as well as range-specific and U.S. Navy standard operating procedures.

The Clean Water Act prohibits the discharge of hazardous substances into or upon U.S. waters out to 370 kilometers (200 nautical miles). Also shipboard waste handling

procedures for commercial and U.S. Navy vessels govern the discharge of hazardous wastes as well as non-hazardous waste streams. These categories include "blackwater" (sewage); "greywater" (leftover cleaning water); oily wastes; garbage (plastics, non-plastics, and food-contaminated waste); hazardous wastes; and medical wastes. (U.S. Department of the Navy, 2002b)

The Uniform National Discharge Standards provisions of the Clean Water Act provide for the evaluation of the 39 discharges from U.S. Navy Vessels. Section 312(n)(2)(B) of the Clean Water Act identifies seven factors for consideration when determining if a discharge requires a marine pollution control device: the nature of the discharge; the environmental effects of the discharge; the effect that installing or using the marine pollution control device has on operations or the operational capability of the vessel; applicable Federal and state regulations; applicable international standards; and the economic costs of installing and using the marine pollution control device.

Under the regulations implementing the Act to Prevent Pollution from Ships, as amended, and the Marine Plastics Pollution Research and Control Act, the discharge of plastics, including synthetic ropes, fishing nets, plastic bags, and biodegradable plastics, into the water is prohibited. A slurry of sea water, paper, cardboard, or food waste that is capable of passing through a screen with opening no larger than 12 millimeters (0.4 inch) in diameter may not be discharged within 5.6 kilometers (three nautical miles) of land. Discharge of floating dunnage, lining, and packing materials is prohibited in navigable waters and in areas offshore less than 46.3 kilometers (25 nautical miles) from the nearest land.

Test event sponsors would be responsible for tracking hazardous wastes; for proper hazardous waste identification, storage, transportation, and disposal; and for implementing strategies to reduce the volume and toxicity of the hazardous waste generated. For test events using a sea-based platform, hazardous materials and hazardous waste would be managed in accordance with all applicable state and Federal regulations as well as Range-specific and U.S. Navy standard operating procedures.

The transport, receipt, storage, and handling of hazardous materials would comply with Army TM 38-410, Navy NAVSUP PUB 505, Air Force AFR 69-9, Marine Corps MCO 4450-12 or Defense Logistics Agency DLAM 4145.11, Storage and Handling and Implementing Regulations Governing Storage and Handling of Hazardous Materials.

3.2.10.6 Health and Safety

The region of influence for health and safety in the BOA would be limited to work crews located on sea-based platforms. The WorldWide Navigational Warning Service is a worldwide radio and satellite broadcast system for the dissemination of Maritime Safety Information to U.S. Navy and merchant ships. The WorldWide Navigational Warning

Service provides timely and accurate long range and coastal warning messages promoting the safety of life and property at sea and Special Warnings that inform mariners of potential political or military hazards that may affect safety of U.S. shipping.

3.2.10.7 Noise

Studies of ambient noise of the ocean have found that the sea surface is the predominant source of noise above the water, and that the source is associated with the breaking of waves. (Knudsen, et al., 1948, as referenced in FAA, 2001a) The primary human-made noise source within the BOA is associated with ship and vessel traffic, including transiting commercial tankers and container ships, commercial fishing boats, and military surface vessels and aircraft. Noise sources above the water would also include launch or other activities from sea-based platforms.

Noise also occurs under the ocean surface. The dominant sources of ambient underwater noise and their corresponding frequency ranges are seismic activity, turbulent-pressure fluctuations, and second order pressure effects due to surface gravity waves (1to 100 Hz); ship traffic and industrial activity (10 Hz to 10 kHz); biologics (10 Hz to 100 kHz); sea ice activity (10 Hz to 10kHz); breaking waves, bubbles, and spray (100 Hz to 20 kHz); precipitation (100 Hz to 30 kHz); and thermal effects (30 to 100 kHz). Noise from sources above the water may be magnified underwater. For example, a tug and barge produces sound that measures 171 dB in water and 110 dB in air. (Gisiner, 1998)

3.2.10.8 Transportation

The Transportation in the BOA consists predominantly of marine shipping. Marine shipping refers to the conveyance of freight, commodities, and passengers via mercantile vessels.

3.2.10.9 Water Resources

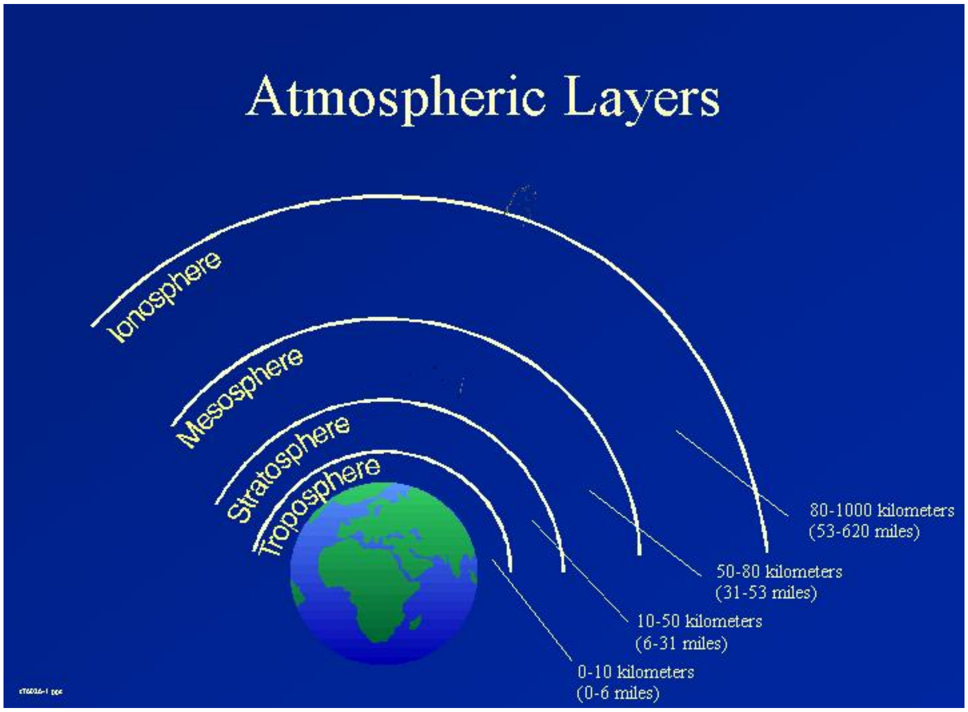
The two main factors that define ocean water are the temperature and the salinity of the water. (UCAR, 2001b) Water quality in the open ocean is considered excellent, with high water clarity, low concentrations of suspended matter, dissolved oxygen concentrations at or near saturation, and low concentrations of contaminants such as trace metals and hydrocarbons

3.2.11 Atmosphere

The Atmosphere Environment refers to the Atmosphere that envelops all areas of the Earth and consists of the four principal layers of the Earth’s atmosphere: troposphere,

stratosphere, mesosphere, and ionosphere or thermosphere.[50] These layers are characterized by altitude, temperature, structure, density, composition, and degree of ionization – the positive or negative electric charge associated with each layer. Altitude ranges for atmospheric layers are described in Exhibit 3-21.

Exhibit 3-21. Altitude Range for Atmospheric Layers



Source: ICF Kaiser for Beal Aerospace, 1998

3.2.11.1 Air Quality

During the past 150 years, combustion of fossil fuels has resulted in increasing concentrations of atmospheric gases that are believed to influence global climate. The temperature of the Earth's atmosphere is determined by three factors: the sunlight it receives, the sunlight it reflects, and the infrared radiation absorbed by the atmosphere. The principal absorbers include CO_2, water vapor, nitrous oxide, chlorofluorocarbons (CFCs), and methane.

3.2.11.2 Airspace

Exhibit 3-22 illustrates the relationship between airspace classifications and atmospheric layers.

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[50] Most resource areas do not apply to the Atmosphere. Therefore, the Affected Environment discussion includes only Air Quality, Airspace, and Biological Resources, and consideration of Orbital Debris.

Exhibit 3-22. Relationship Between Airspace Classifications and Atmospheric Layers

Type of Airspace	Altitude (from MSL)	Atmospheric Layer(s)
Controlled	> 5.5 kilometers (3.4 miles)	Troposphere, Stratosphere
Uncontrolled	< 4.4 kilometers (2.7 miles)	Troposphere

3.2.11.3 Biological Resources

While the atmosphere generally is not considered to contain biological resources, atmospheric conditions have a direct impact on climate, which affects the location and health of biological resources.

3.2.11.4 Orbital Debris

Although there is no absolute definition of space, it can generally be defined at an altitude approximately 100 kilometers (62 miles) from the Earth's surface, where the aerodynamic forces of the thinning atmosphere become so small that the various control surfaces of an aircraft (e.g., rudder, aileron, and elevator) cease to function effectively. Space is not generally considered to be part of the human environment, as defined by NEPA and therefore, the discussion of impacts to space for this PEIS will be limited to the impacts from orbital debris. Orbital debris is man-made material introduced by spacecraft. The debris can be as large as spent rocket motors and as small as dust particles released during motor firings. Orbital debris that remains on orbit could create hazards to orbiting spacecraft, to astronauts or cosmonauts engaged in extra-vehicular space activities and it could have impacts upon reentry if the debris reaches the Earth's surface in large pieces or contains hazardous components. The effects of orbital debris on other spacecraft depend on the altitude, orbit, velocity, angle of impact, and mass of the debris. Eventually this orbiting debris loses energy and drops into consecutively lower orbits until it reenters Earth's atmosphere. Orbital debris has no impact on the human environment unless and until the debris enters the Earth's atmosphere. De-orbiting debris (i.e., debris reentering the atmosphere from orbit) is a potential concern as a course of deposition of small particles into the stratosphere, and a possible contributor to stratospheric ozone depletion.

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4 ENVIRONMENTAL CONSEQUENCES

Introduction

This Section of the PEIS describes the potential environmental consequences of implementing the proposed action via Alternatives 1 and 2 in various worldwide biomes, the BOA or the atmosphere. This Section also identifies potential cumulative impacts associated with those alternatives. It is intended to address the impacts in the context of worldwide biomes based on similar ecological characteristics rather than political boundaries. Only BMDS Programs and activities that are considered reasonably foreseeable are analyzed in this PEIS. Programs that are still conceptual in nature are not analyzed in this document.

This PEIS provides a comprehensive, global analytical framework that can support subsequent analysis of specific actions at specific locations, as appropriate. A description of the analytical framework follows in the next section. The manner and extent to which future actions tier from the PEIS is left to the discretion of the preparer. The framework established in this document is intended to serve as a guide for preparing future site-specific documents and does not dictate their preparation.

This PEIS also contemplates BMDS activities outside the jurisdictional limits of the U.S. and therefore beyond the scope of NEPA and other Federal U.S. laws. The DoD addresses these issues primarily in DoD Directive 6050.7 and DoD Instruction 4715.5. See Appendix G for a description of the framework to be used for this process.

Cumulative impacts of Alternatives 1 and 2 are also considered. The CEQ NEPA regulations define cumulative impacts as the impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR § 1508.7).

Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. For this PEIS, potential cumulative impacts are addressed for activities that would occur on a scale similar to the proposed BMDS. Thus, activities were considered that are national or international in scope. Future activities were identified based on review of worldwide rocket launches and commercial and government space programs.

As a result of the public comment process, additional areas of analysis – orbital debris, perchlorate, and radar impacts on wildlife – have been addressed in more technical detail in Appendices L, M, and N, respectively.

Analysis Process

Because of the extensive nature of this project, this PEIS analyzes the BMDS as described in the following four steps.

- **Step 1 – Identify and Characterize Activities** for each BMDS component.
- **Step 2 – Identify Activities with No Potential for Impact** and dismiss those for which prior NEPA analysis determined insignificant impacts or those that are categorically excluded.
- **Step 3 – Identify Similar Activities across Life Cycle Phases** for activities that are determined to have similar environmental impacts.
- **Step 4 – Conduct Environmental Analyses** for the remaining life cycle activities for each component.

Step 1 – Identify and Characterize Activities

The BMDS is organized by component (i.e., weapons; sensors; C2BMC; and support assets). Each component has life cycle activities associated with developing, testing, deploying, and decommissioning those components within the BMDS. These activities produce environmental impacts which are examined in this PEIS.

To consider impacts of the BMDS, the emissions/stressors from the component life cycle activities were identified and characterized. Exhibit 1-3 displays the typical activities within each life cycle phase for each component.

Step 2 – Identify Activities with No Potential for Impact

Actions for which previous NEPA analyses indicated no significant impacts[51] or actions that are normally categorically excluded[52] were not analyzed in detail in this PEIS. Exhibit 4-1 identifies activities for which categorical exclusions are generally available. These activities are not further analyzed in this PEIS.

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[51]After scrutinizing NEPA documents for programs and elements (see Appendix D), it was determined that there was no significant impact from several BMDS life cycle activities because these activities have been previously analyzed and were shown to have no impact.

[52] In accordance with CEQ regulations for implementing NEPA (40 CFR 1507.3(b)), the DoD and military services have developed regulations that provide for the establishment of categorical exclusions (40 CFR 1507.3(b)) for those actions, which do not individually or cumulatively have a significant impact on the human environment. Where appropriate, DoD and military services have established categorical exclusions for such activities. For example, infrequent, temporary (less than 30 days) increases in air operations up to 50 percent of the typical installation aircraft operation rate are categorically excluded. See Appendix G, Exhibit G-1 for citations of DoD NEPA implementing regulations categorical exclusions.

Exhibit 4-1. Life Cycle Activities Determined to Have No Significant Environmental Impact

Life Cycle Phase	Activities
Development	Planning/Budgeting
	Research and Development
	Systems Engineering
	Tabletop Exercises
Deployment	Training

Some activities such as transportation of components, maintenance and sustainment, and manufacturing were determined to need no further analysis in this PEIS either because they have been categorically excluded or addressed in previous NEPA analyses and found to have no significant impacts. The rationale for these conclusions is presented in Sections 4.1.1.8, 4.1.1.9, and 4.1.1.10, respectively, of this PEIS.

Step 3 – Identify Similar Activities across Life Cycle Phases

The remaining activities with the potential for environmental impacts were then examined to determine which had similar environmental impacts. For example, impacts associated with site preparation and construction in the development phase would be similar to or the same as impacts from site preparation and construction activities in the testing and deployment phases of the life cycle. Accordingly many activities were addressed together to eliminate redundancy.

Many activities in the various life cycle phases have been combined in the analysis of Support Assets. This was done because activities associated with support assets whether infrastructure, equipment or test assets (including countermeasures and simulants), were considered similar in terms of impacts created. Some activities require the use of operating platforms, such as aircraft for air-based components or ships for sea-based components; these specific platforms are considered support assets. Impacts from the use of operating platforms are discussed as part of Support Assets. Details of the life cycle phase analysis are provided below (Life Cycle Phase Activities). Exhibits 4-2 through 4-5 illustrate by life cycle phase, the activities that are analyzed in this PEIS and the corresponding section in which the analysis can be found.

Step 4 – Conduct Environmental Analyses

The significance of an impact that an activity has on the environment is a function of the nature of the receiving environment. For example, a booster launch has different emissions than those from activating a chemical laser. Whether those emissions create

impacts and the degree of significance of these impacts depends upon the environment in which they are released.

In this analysis, the PEIS considers the emissions/stressors from each component's activity in the context of each resource area (e.g., air, water, etc.). Impacts were distinguished based on the different operating environments (land, sea and air for Alternative 1 and land, sea, air and space for Alternative 2) in which the activity would occur. These impacts were further distinguished based on the worldwide biomes in which the activity would occur.

As a result, the PEIS is organized by component; the analysis examines each resource area and distinguishes between operating environments in the context of a particular biome. The analysis also describes where the impacts differ based on the operating environment or biome.

Life Cycle Phase Activities

Development Phase Activities

Exhibit 4-2 shows the activities in the development life cycle phase that were considered to produce environmental impacts and where in the analysis each activity is addressed. Planning and budgeting; research and development; systems engineering; and tabletop exercises are activities for which categorical exclusions are generally available; therefore these activities are not further analyzed in this PEIS. Manufacturing of prototypes and maintenance and sustainment are routine activities that have been considered in previous NEPA analyses and determined to have no significant impact or are categorically excluded and are not considered further in this PEIS. Site preparation and construction and testing are part of other life cycle phases for the proposed BMDS. To eliminate redundancy these activities are addressed together. Testing of component prototypes has been assumed to cause the same or similar impacts as testing of component as described for the test life cycle phase.

Exhibit 4-2. Analysis of Impacts of Development Phase Activities

Activity	Source of Impact	Impacts Analysis
Planning/Budgeting	None	Routine activity categorically excluded; not further analyzed
Research and Development	None	Routine activity categorically excluded; not further analyzed
Systems Engineering	None	Routine activity categorically excluded; not further analyzed

Exhibit 4-2. Analysis of Impacts of Development Phase Activities

Activity	Source of Impact	Impacts Analysis
Site Preparation and Construction	Construction or modifications necessary to support component prototype development	Section 4.1.1.9 Support Assets - Infrastructure
Maintenance or Sustainment	Activities related to hardware or software upgrades or maintenance of component prototypes	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.9 Support Assets - Infrastructure
Manufacturing of Prototypes	Manufacturing of component prototypes	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
Testing of Component Prototypes	Activities related to activation or use of the component prototypes	Sections 4.1.1.1 Weapons - Lasers, 4.1.1.2 Weapons - Interceptors, 4.1.1.3 Sensors - Radar, 4.1.1.4 Sensors - Infrared and Optical, 4.1.1.5 Sensors - Laser, 4.1.1.6 C2BMC - Computer Terminals and Antennas, 4.1.1.7 C2BMC - Underground Cable, 4.1.1.8 Support Assets - Equipment, 4.1.1.9 Support Assets - Infrastructure, 4.1.1.10 Support Assets - Test Assets
Tabletop Exercises	None	Routine activity categorically excluded; activity not further analyzed

Test Phase Activities

Test life cycle phase activities were considered in two distinct analyses; one focused on the components and their individual test activities, and the other focused on System Integration Testing which could include multiple components with one or more attempted intercepts to test system capability and effectiveness in increasingly robust and realistic test scenarios.

BMDS *component testing activities* assumed to have potential impacts on the environment were considered for each component as shown in Exhibit 4-3. Some of the activities that comprise the test life cycle phase are unique to individual components. For example launch/flight is relevant for interceptors and targets but not for C2BMC. Test life cycle phase activities are specific to each component. Therefore, Exhibit 4-3 is presented by component and shows those specific activities that were determined to have the potential for impact. Other activities such as site preparation and construction are not unique to individual components and are therefore considered collectively in Support Assets. The impacts associated with a target intercept involving either laser or interceptor weapons are addressed as part of Test Integration.

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
Weapons-Laser	Manufacturing of Test Articles	Manufacturing/assembly of laser components and chemicals	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support laser use/firing	Section 4.1.1.9 Support Assets - Infrastructure

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
	Transportation	Transport of the laser and chemicals to appropriate location	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Firing the laser	Section 4.1.1.1 Weapons - Lasers
Weapons-Interceptor	Manufacturing of Test Articles	Manufacturing interceptor components and propellants	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support launch	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of the booster, kill vehicle, and propellants to the launch location	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Prelaunch	Assembly and fueling of the booster or kill vehicle, as appropriate	Section 4.1.1.2 Weapons - Interceptors

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
	Launch/Flight	Ignition of rocket motors and flight of boosters or separation of kill vehicle and subsequent flight along its trajectory	Section 4.1.1.2 Weapons - Interceptors
	Postlaunch	Clean up or debris recovery, if required	Section 4.1.1.2 Weapons - Interceptors
Sensors	Manufacturing	Manufacturing/assembly of the sensor hardware and software	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support sensor use	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of the sensor to appropriate location	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Use of the sensor	Sections 4.1.1.3 Sensors - Radar, 4.1.1.4 Sensors - Infrared and Optical, and 4.1.1.5 Sensors - Laser

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
C2BMC	Manufacturing	Assembly of associated hardware and software	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modification for computer terminals, antennas, and underground cable trenching	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of C2BMC to appropriate location	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Use of computer terminals, antennas, and underground cable	Sections 4.1.1.6 C2BMC - Computer Terminal and Antennas, 4.1.1.7 C2BMC - Underground Cable

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
Support Assets-Support Equipment	Manufacturing	New or major modification of existing support equipment	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Operational Changes	Implementation of new operating parameters of existing support equipment	Section 4.1.1.8 Support Assets - Equipment
	Site Preparation and Construction	New construction or major modification of existing infrastructure	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of support equipment	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
Support Assets-Infrastructure	Site Preparation and Construction	Construction or modification of infrastructure	Section 4.1.1.9 Support Assets - Infrastructure

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
Support Assets- Test Assets	Manufacturing	Assembly of hardware/software associated with the test sensor	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
	Site Preparation and Construction	Construction or modifications necessary to support the test sensor or launch	Section 4.1.1.9 Support Assets - Infrastructure
	Transportation	Transport of the sensor, booster and propellants to the test location	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets - Equipment
	Activation	Use of the test sensor in a test event	Section 4.1.1.3 Sensors - Radar, 4.1.1.4 Sensors - Infrared and Optical, and 4.1.1.5 Sensors - Laser
	Prelaunch	Assembly and fueling of the booster as appropriate	Section 4.1.1.2 Weapons - Interceptors

Exhibit 4-3. Analysis of Impacts of Test Life Cycle Phase Activities

Component	Activity	Source of Impact	Impacts Analysis
	Launch/Flight	Ignition of rocket motors, separation from launch platform, and flight of the boosters or separation of the target object and subsequent flight along its trajectory	Section 4.1.1.2 Weapons - Interceptors
	Use of Countermeasures, Simulants or Drones	Use and deployment of various countermeasures, simulants or drones to support testing	Section 4.1.1.10 Support Assets - Test Assets
	Postlaunch	Clean up or debris recovery to include launch platform, countermeasures, and simulants, if required	Section 4.1.1.2 Weapons - Interceptors

The operating environments in which test activities occur (i.e., land, sea, air, and space) were determined to influence the environmental impacts only for laser activation, launch/flight activities, sensor activation, and activation of C2BMC. Therefore, these activities were also considered by operating environment in analyzing their environmental effects. Individual component tests are needed to demonstrate the functionality of BMDS technology. Potential environmental consequences of component tests are discussed in previous NEPA documentation and in their respective sections in this PEIS.

BMDS *System Integration Testing activities* would occur at the system level. System Integration Tests evaluate the ability of various component configurations to work together. System Integration Testing would be used to assess the ability of BMDS components to work interoperably and to meet the required functional capabilities of the BMDS as a system and to demonstrate performance.

System Integration Tests would integrate existing and planned components such as sensors, weapons, and C2BMC. This PEIS assesses the potential for environmental impacts of integrated BMDS testing activities under Alternatives 1 and 2. Test integration activities would involve land-, sea-, and air-based operating environments for weapons; and land-, sea-, air- and space-based operating environments for sensors, C2BMC, and support assets for Alternative 1. Assessment of Alternative 2 considers

only the additional impacts of proposed space-based operating environment for interceptors.

System level tests would include modeling, simulation, and analysis; integrated missile defense wargames; MDIE; integrated GTs; and SIFTs. A description of each type of test is provided in Exhibit 2-22.

The analysis of intercept impacts includes discussion of the impact of debris from an intercept. Depending on the location used for testing or deployment of weapons, debris may impact either inland or in marine environments. Therefore, impacts from postlaunch activities involving intercepts have been subcategorized based on where intercept debris would be likely to impact. For purposes of this PEIS, it was assumed that the debris impacts from any single intercept would occur within a single receiving environment, either on land or in water.

Deployment Phase Activities

Deployment phase activities with the potential for impacts on the environment would include manufacturing (production) of components, site preparation and construction, use of human services, transportation of components to the deployment site, testing (prelaunch, launch/flight, activation, postlaunch), training, and maintenance or sustainment of the components (operation and maintenance, upgrades, and service life extension). The environmental impacts associated with maintenance including hardware and software upgrades and service life extension are routine activities that are generally categorically excluded and are not analyzed in this PEIS. The environmental impacts associated with manufacturing, site preparation and construction, and transportation, and human services are routine activities that are generally categorically excluded or are analyzed in previous NEPA documents and found to have no significant impact. The rationale for why they are not analyzed in this PEIS is provided in Support Assets. The environmental impacts associated with training would be similar to the use of the component as described under the testing life cycle activity.

Future deployment of BMDS components would occur at times and places where the deployed component would provide the most useful defensive capability to counter existing or emerging threats. This could include sites outside the continental U.S. The environmental impacts of deployment at specific locations would need to be considered in subsequent site-specific NEPA analyses tiered from this PEIS. The activities and associated impacts from deployment phase activities are presented in Exhibit 4-4.

Exhibit 4-4. Analysis of Impacts of Deployment Phase Life Cycle Activities

Activity	Source of Impact	Impacts Analysis
Manufacturing	Manufacturing (production) of the component	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.10 Support Assets - Test Assets
Site Preparation and Construction	Construction or modifications necessary to support component deployment	Section 4.1.1.9 Support - Infrastructure
Transportation	Transporting component to deployment location	Routine activity categorically excluded or analyzed in previous NEPA documents and found to have no significant impact. Rationale presented in Section 4.1.1.8 Support Assets – Equipment
Testing	Activities related to prelaunch, launch/flight, postlaunch, or activation of the component	Testing of components would be the same as or similar to the use of the component as described under the testing lifecycle activity
Maintenance or Sustainment	Activities related to hardware or software upgrades	Activities related to prelaunch, launch/flight, postlaunch, or activation of the component
Upgrades	No source of impact	Routine activity categorically excluded; activity not further analyzed
Training	Activities related to prelaunch, launch/flight, postlaunch, or activation of the component	Testing of components would be the same as or similar to the use of the component as described under the testing life cycle activity
Use of Human Services	Activities related to increasing the presence of staff at deployment sites	The use of human services is more appropriately addressed in site specific documentation. Rationale presented in Section 4.1.1.9 Support Assets - Infrastructure

Exhibit 4-4. Analysis of Impacts of Deployment Phase Life Cycle Activities

Activity	Source of Impact	Impacts Analysis
Service Life Extension	No source of impact	Routine activity categorically excluded; activity not further analyzed

Decommissioning Phase Activities

Typical decommissioning phase activities would include demilitarization and disposal or replacement of the component. Activities associated with decommissioning may include recycling and disposal of hazardous materials. The activities associated with decommissioning are presented in Exhibit 4-5. The environmental impacts associated with decommissioning of specific components would be more appropriately addressed in subsequent tiered environmental analyses.

Exhibit 4-5. Analysis of Impacts of Decommissioning Phase Life Cycle Activities

Activity	Source of Impact	Impacts Analysis
Demilitarization	Destruction of offensive or defensive systems capability which may include disposal or detonation of hazardous materials (propellants, batteries, etc)	A roadmap for considering decommissioning impacts is provided; an analysis would be more appropriately addressed in subsequent tiered environmental analyses.
Disposal	Materials to be disposed may include hazardous materials and hazardous waste (propellants, coolants, batteries, etc.)	A roadmap for considering decommissioning impacts is provided; an analysis would be more appropriately addressed in subsequent tiered environmental analyses.

A roadmap for considering impacts of decommissioning for each component has been developed and is provided below. A Government depot or contractor may accomplish demilitarization and disposal of the components. The military service responsible for managing each piece of equipment would initiate the demilitarization and disposal process. Normally, each individual piece of equipment would have disposition instructions that have been prepared by its development contractor or project office in the case of MDA. These instructions identify the hazardous materials contained in the equipment item. A copy of the disposition instructions would be provided to the depot or contractor performing the demilitarization and disposal. It would be the responsibility of the depot or contractor to identify, remove, segregate, package, and document all hazardous materials in the item. In the case of a depot, disposal of hazardous materials

would be through Government channels as described below. When a contractor is utilized, hazardous materials disposal would be processed through commercial channels in compliance with all applicable Federal, state, and local laws.

When a depot performs the demilitarization and disposal functions, disposal of hazardous and nonhazardous materials would be through a Defense Reutilization and Marketing Office (DRMO). The DRMO would physically accept and process all property that falls within the DRMO area of responsibility. The DRMO would be responsible for disposing of hazardous materials in accordance with applicable Federal, state, and local laws, utilizing best management practices.

Components would be transported to demilitarization and disposal locations by the method appropriate to their location and military sensitivity. Transportation to contiguous land areas could be by ground (truck or rail) in accordance with DOT, state and local transportation and safety regulations and procedures. Transportation from, or to, island locations would be by aircraft in accordance with DOT and U.S. Air Force regulations and procedures, or by U.S. Navy, U.S. Army, or commercial ships in accordance with U.S. Coast Guard and Maritime Administration requirements and any other applicable regulations and procedures.

Potential decommissioning activities for weapons, sensors, C2BMC, and support assets are discussed below.

Decommissioning of ***weapons*** components would involve transferring the equipment to other uses, as described above, or demilitarization in accordance with the requirements of DoD 4160.21-M-1, Appendix 4 "*Demilitarization Requirements for Munitions List Items*." Specific requirements are found in DoD 4160.21-M-1, Appendix 4, Category IV, "*Launch Vehicles, Guided Missiles, Ballistic Missiles, Rockets, Torpedoes, and Components*," and DoD 4160.21-M-1, Appendix 4, Category V "*Military Explosives, Solid and Liquid Propellants, Bombs, Mines, Incendiary Agents, and Their Constituents*." Because the BMDS does not include nuclear weapons, the requirements of DoD 4160.21-M-1, Appendix 4, Category XVI, "*Nuclear Weapons Design and Test Equipment*," would not apply to the decommissioning of weapons components. Examples of potential decommissioning plans for missiles (interceptors and targets) are included below.

Decommissioning of missiles would first require the removal and proper disposal of liquid, solid, or hybrid (liquid and solid combination) propellants from the booster(s). Where possible, propellants would be recovered and reused. Aging motors that contain flaws would likely be decommissioned using open detonation. Some liquid fueled missiles are fueled only before a scheduled launch; others are pre-fueled. In addition, the kill vehicle on an interceptor missile typically uses liquid hypergolic propellants and some solid propellants for its divert and attitude control system. Liquid propellants would need to be emptied before disassembly of the missile could occur. Solid rocket

propellant would be removed for reclamation or burning in a controlled environment, such as an incinerator. Where practicable, incineration or closed burning of rocket propellant would be performed. Most of the acid and particulates ejected during the burn would be collected in plume scrubber water. This water would be treated for acceptance by a publicly owned (or federally owned) water treatment works or discharged in accordance with a National Pollutant Discharge Elimination System (NPDES) permit.

Decommissioning of lasers would require the removal and proper disposal or neutralization of chemical laser fuels from the storage facilities. Where possible, these chemicals would be recovered and reused. Decommissioning of the aircraft would be conducted in accordance with DOD 4160.21-M-1, Appendix 4, Category III, "*Military Aircraft (Combat, Tactical Air Vehicles) Spacecraft and Associated Equipment*" and other applicable requirements. Decommissioning activities for other laser components would be conducted as appropriate in accordance with applicable regulations.

The MDA would develop new ***sensor*** equipment in addition to using a variety of existing equipment. Equipment intended only for testing purposes and not for use in the BMDS architecture would be returned to the responsible military service for continuation of its original duties. Any decommissioning activities for this equipment would be carried out by the responsible military service. Equipment would be demilitarized in accordance with DoD 4160.21-M-1, Appendix 4, Category XII "*Fire Control, Range Finder, Optical, and Guidance and Control Equipment.*"

The decommissioning of sensors, equipment, and facilities would include the recycling/reuse or disposal of residual materials and unused products associated with the antennae, electronic, cooling, and power units. These products would include but are not limited to lubricants, coolants, batteries, and fuels. These materials would be decommissioned in accordance with Chapter 10, Environmentally Regulated and Hazardous Property, of the (DoD) Directive 4160.21-M, *Defense Reutilization and Disposal* and any applicable Federal, state, and local regulations and requirements. Reusable materials from sensors, such as metals, would be recovered. Other materials would be shredded and recycled or disposed of, as appropriate.

Sea-based sensors such as the SBX radar use a MOSS CS50 platform to support a radar support structure and radome. The CS50 platform was designed for use in oil exploration. After the sea-based radar system is removed, the platform could be converted to another MDA use (launch platform, test or deployed radar platform, etc.), transferred to a military service, or sold. If another use of the platform is not feasible, DoD would dismantle the platform and dispose of the materials by recycling, reuse, or discarding it in appropriate waste management facilities. DoD could also consider sinking the platform at sea after all toxic materials are removed, to provide a foundation for marine life.

Space-based sensors would be decommissioned by being abandoned in orbit, parked in a higher orbit, deorbited, or retrieved. Space-based sensors left in orbit that have non-BMDS utility could be transferred to alternate uses if economically feasible and the alternate use would not affect national security. Potential alternate uses include monitoring rocket launches and aircraft flights. DoD would make decisions on the disposition of the space-based components based on the stability of their orbits, the costs and risks of deorbiting or retrieval, the remaining useful life of the equipment, and potential for alternate uses.

Components could be retrieved from orbit and brought back to Earth for decommissioning and demilitarization if allowing them to remain in orbit poses unacceptable risks. Components abandoned in orbit would continue to orbit until gravitational and atmospheric drag cause the component to deorbit and reenter the atmosphere where it would either burn up or fall to Earth. Potential risks include danger to populations on Earth or the loss of equipment sensitive to national security. U.S. Space Command tracks orbits of satellites and space debris, and provides reentry predictions. When the predictions indicate a risk to land areas, a controlled deorbit would be considered to ensure reentry occurs over ocean areas. Parking the component in a higher orbit would increase the time before deorbit. Demilitarization of space-based components would be conducted in accordance with DoD 4160.21-M-1, Appendix 4, Category VIII, "*Military Aircraft (Combat, Tactical Air Vehicles), Spacecraft and Associated Equipment*," Category XI, "*Military and Space Electronics,*" and Category XV, "*Spacecraft Systems and Associated Equipment.*"

The MDA would develop new ***C2BMC*** equipment as well as use a variety of existing equipment. As technology advances and the needs of the BMDS evolve, multiple upgrades of C2BMC hardware and software are likely. DoD would be responsible for decommissioning activities in accordance with appropriate requirements for the specific C2BMC equipment.

Support assets include fixed facilities and mobile equipment as well as test assets including the test bed, test sensors, and targets. This discussion of decommissioning activities focuses on fixed and mobile equipment. Components that make up the test bed, test sensors and targets are addressed previously under decommissioning weapons and sensors.

Fixed facilities may include DoD-owned buildings located on ranges, installations, or related real estate such as islands temporarily used for BMDS purposes. Government contractor facilities include such sites as the Nevada Test Site and Sandia National Laboratory in New Mexico. Privately owned facilities include those owned by companies manufacturing components for the BMDS. Exhibit 4-6 describes decommissioning activities for fixed facilities.

Exhibit 4-6. Decommissioning Activities for Fixed Facilities

<table>
<tr><th colspan="2" rowspan="3">Fixed Facilities</th><th colspan="4">Decommissioning Activities</th></tr>
<tr><th colspan="3">Left in Place</th><th>Disposed</th></tr>
<tr><th>Mission Realignment</th><th>Return to Owners/Host Facility</th><th>Transfer Title to New Owner</th><th>Transfer Land Title to New Owner</th></tr>
<tr><td rowspan="3">Buildings</td><td>DoD-owned</td><td>X</td><td></td><td>X</td><td>X</td></tr>
<tr><td>Government Contractor</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Private</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td rowspan="5">Launch Locations</td><td>DoD Launch Pads/Runways</td><td>X</td><td></td><td>X</td><td>X</td></tr>
<tr><td>Silos</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>Other Government</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Private</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Municipal Airports (runways)</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td rowspan="3">Utilities</td><td>Water/Sewer Systems</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Power Plants (gas and coal fired)</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Fiber optic and Other Cables</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>

Fixed buildings or structures could include those used for testing purposes, deployment, or both. As described above, the MDA would evaluate DoD-owned buildings for continued or adaptive use by the DoD or other U.S. Government agencies. Following the decision to decommission, any necessary decontamination activities would be performed. Buildings owned by the DoD that are not assigned new missions could be sold and the title transferred to the new owner. Any space devoted to BMDS activities in government contractor or contractor facilities would be returned to the host installation. All BMDS-related equipment would be removed according to decommissioning regulations.

Other fixed BMDS components include launch pads, in-ground missile silos, and runways. Launch pads, silos, and runways located at the various DoD installations, upon completing their BMDS mission, might be assigned new DoD missions and might not

need to be decommissioned. Other government launch facilities include those run by the NASA such as Kennedy Space Center.

Private facilities include those owned by states or private organizations such as the KLC, which is run by the Alaska Aerospace Development Corporation. Upon termination of any BMDS testing or deployment activities conducted on the grounds of these facilities, any private assets and components used by MDA to support testing or deployment would be returned to full control of the host installation or otherwise disposed per existing contractual agreement.

Utilities installed in new or existing facilities as part of the BMDS mission would include water/sewer systems and fiber optic or other cables. Depending on the decommissioning decision related to any related DoD-buildings or structures, utilities could be left in place if the potential existed to use them for future DoD or other entity purposes. They would either be passed to the existing owner or host installation if installed on contractor property. Should a related structure be transferred to a new owner, utilities likely would be left in place.

The scope of the BMDS includes some testing and potential deployment at locations abroad. Decommissioning options for international buildings, launch locations, or utilities would be the same as for domestic locations. However, it is expected that the extent of the BMDS presence in other countries would be less than in the continental U.S.

Mobile land-based components include transportation vehicles (e.g., trucks, vans and trains) and missile launchers. Equipment removed from the mobile land-based components would be refurbished and transferred to an alternate use, demilitarized, or dismantled and disposed. Upon completion of their BMDS mission, DoD-owned transportation vehicles would either be assigned another mission or be disposed or sold by DoD. Vehicles owned by government contractors or private companies would be returned to their original owners following any decontamination required. Missile launchers, such as the THAAD mobile launcher, which uses a U.S. Army Heavy Expanded Mobility Tactical Truck with Load Handling System Truck would be disassembled and disposed. Some missile launcher interiors were coated with a specialized paint containing chromium. Disposal of chromium contaminated paint dust or water used in the removal of the paint would require disposal according to applicable Federal and State regulations.

Following the decision to decommission, any necessary decontamination activities would be performed. Land areas would be restored to previous conditions or other condition compatible with planned land use of the site. Demilitarization of land-based components would be conducted in accordance with the applicable category of DoD 4160.21-M-1, Appendix 4 "*Demilitarization Requirements for Munitions List Items,*" or other applicable requirements. Disposal of land-based components would involve the removal

of BMDS equipment and assets. The components could be left in place and a new mission assigned for them. The components could be returned to the owners of the host facility (if not DoD-owned) or transferred to new owners. Transfer would occur under an interagency agreement, memorandum of understanding, lease agreement, or other agreement.

The MDA would decommission the three current airborne sensor aircraft (HALO I, HALO II, and Widebody Airborne Sensor Platform [WASP]) and future airborne sensors when they are no longer needed to support the MDA testing program. MDA would remove the sensors and other government property from the aircraft and then decommission the aircraft by transferring to another government agency, selling as excess government property, salvaging usable parts, or mothballing at a government airfield. MDA is currently purchasing the HALO aircraft.

Under the Measurements Program, countermeasures would be recycled or reused for alternate DoD missions. Simulants and submunitions used for lethality testing also would be recycled or reused, where possible, or disposed in accordance with applicable regulations.

4.1 Alternative 1 – Implement BMDS Using Land-, Sea-, and Air-Based Weapons Platforms

4.1.1 BMDS Components

The following analyses are organized by component and subcomponent. The analyses are specific to each resource area (i.e., air quality, airspace, biological resources, geology and soils, hazardous materials and hazardous waste, health and safety, noise, transportation, and water resources) based on the impacts from the life cycle activities associated with each component. Where activities that are not unique to the life cycle phase or component and have the potential to result in similar environmental impacts, they were addressed together to eliminate redundancy. Where activities that are not unique to an individual component and have the potential to result in similar environmental impacts, they were addressed together to eliminate redundancy. As previously discussed under the Description of Life Cycle Activities and Development Phase Activities, manufacturing, site preparation and construction, and transportation of components are discussed under Support Assets. Because such activities would be performed by or on support assets, the impacts from manufacturing, site preparation and construction, and transportation activities associated with each BMDS component are discussed under Support Assets.

4.1.1.1 Weapons - Lasers

As described in Exhibit 4-3, the analysis for lasers is based upon impacts from the activation of the laser.

Air Quality

Operation of a COIL would result in gaseous emissions of water vapor, CO_2, oxygen, helium, nitrogen (N_2), ammonia, chlorine, H_2, and iodine. Liquid hydrogen peroxide also would be released. Ammonia and chlorine are hazardous substances. At altitude, the gases produced by the laser are exhausted into the air. During activation from land and sea platforms (assuming that sea-based laser activation was done under the same test conditions used for ground testing), most of the gaseous emissions produced by the laser would be captured in an air pollution scrubber. The estimated quantities released and scrubbed (for laser activation from land and sea platforms) in a single lasing event are shown in Exhibit 4-7. (U.S. Department of the Air Force, 1997b)

Exhibit 4-7. Estimated In-Flight COIL Gaseous Emissions in Kilograms (Pounds)*

Chemical	Total Quantity Produced per Laser Activation Kilograms (Pounds)	Quantity of Emissions Released to Atmosphere for Air Platform Laser Activation Kilograms (Pounds)	Quantity of Emissions Captured in Solution by Scrubber for Land and Sea Platform Laser Activation Kilograms (Pounds)	Quantity of Emissions Released to Atmosphere for Land and Sea Platform Laser Activation Kilograms (Pounds)
Ammonia (recovered in closed-loop system)	N/A	N/A	N/A	N/A
Carbon dioxide	761 (1,677)	761 (1,677)	0 (0)	761 (1,677)
Chlorine	29 (63)	29 (63)	24 (53)	5 (10)
Helium/N_2	86 (190)	86 (190)	0 (0)	86 (190)
H_2	20 (43)	20 (43)	0 (0)	20 (43)
Iodine	10 (23)	10 (23)	9 (20)	1 (3)
Oxygen	219 (483)	219 (483)	0 (0)	219 (483)
Water	1,389 (3,063)	1,389 (3,063)	1,181 (2,603)	209 (460)

*Calculations subject to rounding
Source: U.S. Department of the Air Force, 1997b

Land and Sea Operating Environments

Impacts to air quality from the activation of the COIL from land or sea platforms would be minimal, given the short duration of the laser operation (less than 30 seconds [U.S. Department of the Air Force, 1997b]) and the propensity of hot gases in the emission

cloud to rise. Because a small amount of chlorine may remain after scrubbing and be released to the atmosphere, rain within two hours of laser activation could cause hydrochloric acid to form and be deposited in small quantities. (U.S. Department of the Air Force, 1997b)

Under high humidity or rainy conditions, chlorine exhaust would be removed from the atmosphere in a shorter amount of time, as the chlorine is converted to hydrochloric acid. Because of their humid climates hydrochloric acid would likely be produced as a result of laser activation in a number of biomes including Arctic Tundra Coastal, Sub-Arctic Taiga Coastal, Deciduous Forest, Deciduous Forest Coastal, and Mountain Biomes. In addition, hydrochloric acid could be produced in the Sub-Arctic Taiga, Chaparral, Grasslands, and Savanna Biomes when cool and humid conditions exist during laser activation activities. The strong winds in the BOA would support the rapid dispersion of emissions. Given the dry conditions in the Desert Biome, it is unlikely that chlorine would be converted to hydrochloric acid. The Tropical Coastal Biome is generally humid but the temperatures do not cool enough to convert any chlorine produced as a result of laser activation to hydrochloric acid.

Hydrochloric acid produced as a result of the interaction between laser emissions and moisture in the air has the potential to produce impacts on biological resources, including plants and aquatic animals, and water quality. The extent and relative significance of the impact depends on the site-specific receptors present at the location. However activation of lasers, in general, would result in a small amount of chlorine being converted to hydrochloric acid, which would be further diluted by rain water.

Air Operating Environment

Impacts to air quality from laser activation from air platforms would result in similar impacts to those discussed above for land and sea operating environments. However, the potentially harmful substances would be released at approximately 12,192 meters (40,000 feet) above the Earth’s surface and therefore, would be less likely to affect ground-level air quality. High exhaust gas temperature would result in positive buoyancy, allowing the exhaust emissions to rise quickly. The high exit velocity of the exhaust gases and the chemical composition of the exhaust would further increase the rate of dispersion and increase the altitude at which dispersion occurs. Therefore, the gases would not accumulate in any significant quantities, and no significant impact to air quality would be expected due to activation of lasers from air operating environments. (U.S. Army Space and Strategic Defense Command, 1998b)

If the COIL were operating in the upper reaches of the troposphere and in the lower stratosphere (up to 12 kilometers [7 miles]), chlorine exhaust emissions would be converted quickly to forms that dissolve in water and would be removed from the

atmosphere. (U.S. Department of the Air Force, 1997b) Chlorine may be converted to hydrochloric acid, which has the potential to increase the acidity of precipitation.

Ammonia is water-soluble and would dissolve in water and be removed from the atmosphere in approximately 20 days. (Seinfeld, 1986, as referenced in U.S. Department of the Air Force, 1997b) Emissions of chlorine and ammonia from the COIL would be insignificant compared to the amount of chlorine and ammonia released by industrial sources every year. (U.S. Department of the Air Force, 1997b) Emissions of CO_2 associated with operation of the COIL would be minimal and would not be expected to contribute significantly to global warming.

Chlorine is capable of destroying ozone, which is beneficial in the upper atmosphere for blocking harmful rays from the sun. If the emissions occur in the lower stratosphere (above the troposphere), the local concentration of chlorine would increase approximately 35 percent for a short period of time (less than 24 hours). (MDA, 2003a) The increased levels would return to background levels within several hours as atmospheric winds disperse the chlorine. Operation of the COIL in the stratosphere would be spread out over time, thereby eliminating the possibility for local, cumulative effects.

In the event that the aircraft is unable to land at the appropriate landing location, it may be necessary to jettison aircraft fuel and laser chemicals. The laser chemicals could be discarded at a minimum altitude of at least 4,572 meters (15,000 feet). Chemical dispersion modeling has shown that release of liquids used by the COIL at this altitude will not reach the ground and would be diluted in the atmosphere. (MDA, 2003a) Laser chemicals include hydrogen peroxide, ammonia, chlorine, helium, N_2, and iodine. Iodine would be carried as a solid and would not be jettisoned. If the chemicals could not be released at or above this height, the laser chemicals would remain onboard until the air operations could be grounded.

B-747 aircraft would be used for air-based lasers. B-747 fire suppression systems contain 150 kilograms (330 pounds) of Halon 1301 and 9 kilograms (20 pounds) of Halon 1211, both of which are Class I ozone-depleting substances that contribute to ozone depletion when released to the atmosphere. Use of Halon CFC fire suppression systems would take place only in emergency situations, which would be extremely rare. In the case of a fire, the amount of Halon released would be small compared to the amount of CFCs already present in the atmosphere. Fire suppression substitutes are being developed and evaluated and may be available for future operation of lasers in an air operating environment.

Airspace

Land and Sea Operating Environments

Ground testing of HELs that would occur in indoor facilities would have no effect on airspace in any biome considered in this PEIS. Outdoor activation of lasers from land or sea operating environments could impact the use of airspace. Close coordination with the FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impacts on airspace use. Activation of lasers would occur in cleared airspace within designated airspace areas.

Air Operating Environment

Laser activation from air platforms would occur at an altitude of approximately 12,192 meters (40,000 feet). The laser beam would be pointed horizontally or upward. Activation of lasers would occur in cleared airspace within designated airspace use. Close coordination with the FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impacts on airspace use.

Biological Resources

Land and Sea Operating Environments

Ammonia and chlorine produced from the land- and sea-based operation of the COIL could harm underlying vegetation and wildlife. Chlorine is known to injure plant leaves and affect wildlife. Direct effects could include discoloration, foliage loss, and changes in species composition. (U.S. Department of the Air Force, 1997b) Birds flying through the exhaust plume might be exposed to concentrations of hydrochloric acid, which could irritate eye and respiratory tract membranes. However, the high temperature of the emissions, the noise produced by support equipment, and visual cues of the emissions would likely cause birds to fly away from the launch area and therefore, prevent them from being exposed to the chlorine exhaust.

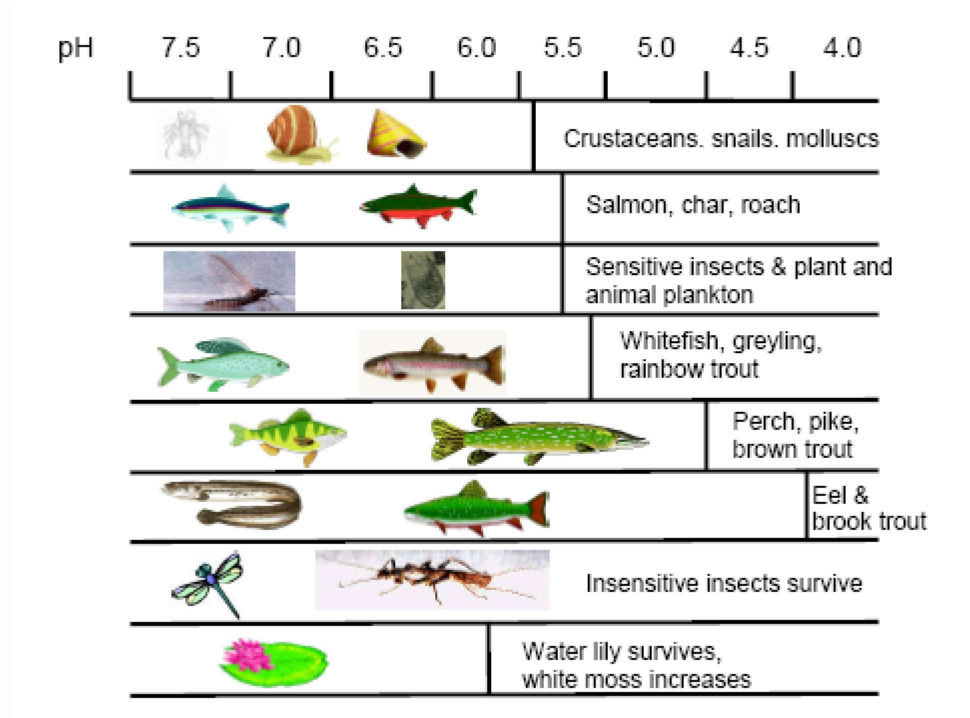
Furthermore, studies involving a variety of laser projects in New Mexico indicate that cumulative impacts to wildlife from laser propagation are negligible. (U.S. Army Corps of Engineers, 1989)

The presence of hydrochloric acid in freshwater bodies may cause temporary increases in water acidity and could alter the regular functioning of the aquatic ecosystem. However, saltwater tends to neutralize acid; therefore, significant acidification does not occur in the ocean and most estuaries, where freshwater and saltwater combine. (EPA, 2003g)

Nonetheless, deposition of HCl into the ocean may create a temporary hazard to marine wildlife. Special consideration should be given to any potential impacts to Essential Fish Habitat and efforts, such as scrubbing emissions, should be made to mitigate the impacts. Once deposited, hydrochloric acid would be diluted and dispersed by the receiving waters. Impacts would be limited to a small area surrounding the point of contact, as the waves and ocean currents would inhibit widespread deleterious effects to marine wildlife.

In environments where there are water bodies, including bogs, fens, marshes, shallow lakes, rivers, and wetlands, chlorine would be converted to an acidic form, where it could alter the pH of the water body. The activation of lasers would not be expected to cause a significant increase in water acidity; however, site-specific analyses would be needed to consider specific impacts to individual locations. In general, the Sub-Arctic Taiga Coastal, Deciduous Forest, Deciduous Forest Coastal, and Mountain Biomes are likely to have water bodies that could be affected by an increase in acidity. Much of the Deciduous Forest Biome is already affected by acidic precipitation; therefore, its regional flora and fauna may not be able to tolerate additional acidic toxicity from laser activation. The presence of hydrochloric acid in prairie potholes in the Grasslands Biome could lower the pH of the water (making it more acidic), which could have a negative effect on waterfowl, shorebirds, and waterbirds that stopover during migration and/or breed in the waters. Mountain lakes are particularly sensitive to the effects of acidification because they have soft water, which does not neutralize acid readily. Furthermore, mountain lake ecosystems quickly show the effects from an external input. As a result, some mountain lake wildlife might not be able to adapt to a lower pH level quickly enough to absorb the effects of increased water acidity without harm. (PECO/COPERNICUS, 1999) Other biomes including Arctic Tundra Coastal, Sub-Arctic Taiga, Chaparral Coastal, Desert, Tropical Coastal, BOA, and Savanna are unlikely to experience increased acidity in surface waters either because hydrochloric acid is unlikely to be produced as a result of laser activation or because surface water is uncommon in these areas. An increase in acidity could affect pH-sensitive aquatic species, as shown in Exhibit 4-8. This has the potential to adversely affect biodiversity; however, this potential affect would be limited to the areas surrounding the laser activation site. The overall increase in acidity, and therefore, the impact to biodiversity would not be expected to be significant.

Exhibit 4-8. Freshwater Species Tolerance to Acidity



Source: Atmosphere, Climate and Environment Information Programme, 2003

Species including birds, pinnipeds, and sea otters are less likely to be impacted by laser activation related noise than other noises. Given the short duration (less than 30 seconds) and proposed infrequent operation of the lasers, any startle responses in animals would be short-lived and localized to the area near the activation site. (U.S. Department of the Air Force, 1997b)

Indoor testing would be contained and would not damage vegetation or wildlife in any biome. During outdoor testing, laser beams could either be directed upwards toward air targets or horizontally towards ground targets. If the beam were directed at an upward angle, vegetation and terrestrial wildlife would not be affected. The probability of the laser beam striking a bird is very low. If the beam is directed horizontally toward ground targets, it could pose a fire hazard to vegetation or cause skin or eye damage to wildlife. Precautions would be taken to prevent harm to vegetation and wildlife.

When the light energy of the laser beam is focused, damage due to thermal heating of the retina or a photochemical change in the retina would most likely occur (in the same way that a magnifying glass can be used to focus light energy from the sun to produce a hot spot). (Swope, 1969, as referenced in U.S. Department of the Air Force, 1990) Damage to the fovea (a small part of the retina that provides acute vision) could result in a severe visual handicap. If the eye were not focused on the laser source, the light energy would not be focused to a point on the retina but would be spread out over a larger area of the

retina and would not be as likely to cause damage. Also, if the eye were pointed somewhere off to the side rather than directly at the source, any damage to the retina would be outside the fovea and would be less likely to produce severe visual handicap. (U.S. Department of the Air Force, 1990)

Ground testing of ABLs would use equipment that would simulate atmospheric conditions at the altitude where the laser would be used. The equipment would operate for a few minutes or less, and would generate noise that could affect wildlife. This noise could cause flushing in birds and temporary abandonment of nesting and other normal activities. These noises may startle animals and cause them to flee the area and abandon normal activities. However, studies indicate that birds and animals generally return to normal activities within a short time following noise disturbances. (Manci, et al., 1988) Specifically, a 1982 study by Stewart found that birds exposed to 115.6 to 145.5 dBA short intensity noise events returned to their nests within 2 to 10 minutes after the disturbance. (Stewart, 1982, as referenced in Manci, et al., 1988) In addition, a 1980 study by Jehl and Cooper used shotgun blasts and explosives to simulate short duration noise events and found that nesting birds returned within 30 seconds of the disturbance. (Jehl, J.R and C.F. Cooper, 1980, as referenced in Manci et al, 1988)

Air Operating Environment

Impacts to biological resources from laser activation from air platforms would result in similar impacts to those discussed above for land-based operations. However, the potentially harmful substances would be released at approximately 12,192 meters (40,000 feet) above the Earth’s surface and therefore, would be less likely to affect human health, wildlife, or vegetation. Emissions would be diluted and dispersed quickly in the atmosphere. Terrestrial biota would not be exposed to significant concentrations of emissions. The laser beam would be pointed upward; and therefore, the test geometry would prevent the possibility of harming terrestrial wildlife directly from contact with the beam. Because the laser is activated in the upper troposphere or above, the potential for the beam striking birds in flight would be low.

A misdirected laser beam would have virtually no potential to impact any moving or stationary individual animal, either on land, in the air, or in the sea. The light energy would be reduced (i.e., less concentrated) and would be less able to cause injury because the beam’s width would increase due to atmospheric refraction as it approached the Earth’s surface. Exposure to the beam would be extremely short due to the rapidity with which the beam would swing past the animal or would be shut off; and therefore, damage would be minimal. (U.S. Department of the Air Force, 1990)

Geology and Soils

Land Operating Environment

Only small amounts of emissions from the operation of the COIL on the ground would be released and would not be expected to affect geology and soils in any biome. Ground testing equipment would receive the laser emissions and scrub them using a vacuum device before releasing them into the atmosphere. Use of the vacuum system would reduce the amount of emissions that could affect geology and soils.

Under rainy or humid conditions, a small amount of chlorine produced from the operation of the COIL would be deposited on the soil as hydrochloric acid, which could result in a temporary increase in soil acidity that might have a short-term effect on vegetation and soil-dwelling microorganisms. The intensity of the acidic effect is a function of the amount of limestone (calcium carbonate) in the soils.

Soils that are strongly leached (removed of nutrients, including calcium) and therefore, acidic could be adversely affected by the addition of hydrochloric acid which could further increase soil acidity. This could occur in the Arctic Tundra, Sub-Arctic Taiga, Savanna, Mountain and parts of the Deciduous Forest, and Tropical Biomes.

Soils with large amounts of calcium carbonate have nearly unlimited buffering capacities and rarely show effects of acidification. (EPA, 2003g) This would be true for soils in the Grasslands, and parts of the Deciduous Forest including Florida and islands in the Pacific and Atlantic Ocean that are limestone-based. However, many soils common throughout the Deciduous Forest Biome lack calcium carbonate due to the warm, humid climate that leads to rapid weathering and subsequent leaching of minerals in soils, including calcium and therefore might be subject to impacts from increased soil acidity.

The Chaparral and Desert Biomes would be unlikely to produce hydrochloric acid as a result of laser activation and therefore soils in these biomes would not be subject to acid deposition from this source.

Accidental releases of spent laser chemicals would be contained in accordance with site-specific spill plans that minimize impacts on geology and soils. In the case of an accidental fire, liquid and solid laser chemicals would either be consumed or contained. Chemicals consumed by the fire would be released as gases and would not impact geology or soils. Remaining laser chemicals would be contained by spill control measures and would be removed and disposed in accordance with standard procedures.

Air Operating Environment

Activation of lasers from an air platform would generally occur at approximately 12,192 meters (40,000 feet). Emissions would occur above the mixing height and might occur above the troposphere. Gaseous emissions occurring at this altitude would be dispersed and diluted in the atmosphere and would not reach the ground surface. Therefore, there would be no impact to geology and soils.

Sea Operating Environment

Laser activation on sea platforms would result in similar impacts to those discussed for land platforms. The small quantities of substances released would be dispersed by atmospheric winds or the motion of the ocean currents and waves without affecting geology and soils on the ocean floor beneath the sea operating environment.

Hazardous Materials and Hazardous Wastes

Land and Sea Operating Environments

COIL chemicals include chlorine (Cl_2), iodine, and hydrogen peroxide. Effluents from the operation of the HEL are managed by use of chemical scrubbers and chemical reactions that produce non-toxic by-products. The volume of waste would depend on site-specific activities. The use and disposal of hazardous materials would be incorporated into hazardous materials and hazardous waste management documents. Hazardous materials would be stored in a centralized location and Material Safety Data Sheets would be posted at all locations where hazardous materials are stored or used. All waste would be collected and segregated as nonhazardous, hazardous, and possibly special wastes for proper disposal in accordance with Federal, state, local, and DoD requirements. Personnel would follow safety procedures to prevent exposure. All hazardous materials used and hazardous waste generated would be handled in accordance with a Hazardous Waste and Hazardous Materials Standard Operating Procedure Manual as well as applicable legal requirements. (U.S. Army Space and Missile Defense Command, 2002d) Accidental releases of hazardous materials would be contained in accordance with a site-specific spill plan.

Laser activation activities would produce the same hazardous materials and hazardous waste impacts in all of the biomes considered in this PEIS. As discussed above for impacts to geology and soils, ground testing of lasers intended for use from air operating environments would use vacuum and scrubber devices to simulate atmospheric conditions at the proposed operating altitude. Scrubbing would generate hazardous wastewater that would be contaminated and corrosive. This contaminated water would be treated and disposed in accordance with applicable regulations.

Spent laser chemicals would be neutralized and reused elsewhere in the chemical mixing facility or disposed of as waste product. This waste would be handled, treated, and disposed in accordance with standard procedures, preventing the release of contamination. In the case of an accidental fire, liquid and solid laser chemicals would either be consumed or contained. Chemicals consumed by the fire would be released as gases and would not become hazardous waste. Remaining laser chemicals would be contained by spill prevention, countermeasure, and control plans, and would be removed and disposed in accordance with applicable regulations and standard operating procedures. Laser chemical and chemical waste storage areas would operate in accordance with appropriate regulations to minimize impacts from potential spills and/or leaks.

Air Operating Environment

Emissions from laser activation from air platforms would be vented to the atmosphere while the platform is at operational altitude. Thus, emissions would not reach the Earth, and would not require treatment as hazardous waste.

In the event of an accident on the runway causing rupture of fuel bladders on the B-747, the impact on geology, soil, or water resources from the jet fuels and firefighting materials would be similar to the impact from other aircraft accidents. The liquid and solid laser fuels released in an accident on the runway would be consumed by fire or contained, and the gaseous laser fuels would either burn or vent to the atmosphere where they would not impact geology, soils, or water quality.

Health and Safety

Land and Sea Operating Environments

Laser activation activities would produce the same impacts on health and safety in all of the biomes considered in this PEIS. A Material Safety Data Sheet would be made available for each hazardous chemical in use at the facility. Storage specifications for hazardous chemicals would prevent dangerous intermixing of reactive chemicals.

Exhaust emissions from laser activation have the potential to harm human health. A safety zone would be established around the laser during operation to prevent exposure to emissions. The general public and non-operational personnel would not be permitted in the safety zone during operations; and therefore, no impact on health and safety would be expected from exhaust emissions.

Before activation activities are conducted, components would be reviewed for hazards. Personnel would be trained to handle laser chemicals and operate the laser. During ground testing of lasers, the beam would be contained in a beam containment system at

all times. During sea-based operations, a laser hazard zone would be established to prevent non-essential personnel or bystanders from crossing the direct or reflected beam path of the laser.

An accidental release of laser chemicals and chemicals used to support laser operation would have the potential to affect health and safety of workers in the vicinity of the release. The primary scenarios for an accidental release involve the transfer of the reactants from the loading truck to the ground storage tanks, transfer from the storage tank to the test apparatus, a catastrophic storage container failure, and a massive release of hazardous chemicals resulting either from the slow combustion or the detonation of compounds where reactants are stored. (BMDO, 2001) Spill control procedures would be followed on military installations, and emergency response personnel would be trained to respond to such emergencies.

Laser beams can cause serious health problems if they contact the skin or eyes. Hazard distances would be determined for each laser depending on the hazardous and adverse biological impacts it has on the eye or skin. A spherical exclusion area would be established around the laser during operation. While the intended beam direction is the most likely hazard area, the spherical shape of the exclusion area would account for laser scatter, the intensity of which can be as strong as or weaker than the original beam. HELs are dangerous at the source of the laser beam, and they become more dangerous around the focus point, where the beam has the smallest cross-sectional area. The strength of a laser beam is attenuated and scattered as it moves through the atmosphere. Lower energy lasers (such as those used in laser sensing and tracking systems) may not be dangerous at the source of the beam, but may become dangerous around the focus point.

During ground testing activities, the laser beam would be directed away from population centers. Range areas would be used during ground testing and public access to these areas would be restricted. Laser targets would be designed to keep any spectral hazard on the range or to exit at a safe altitude. Hazard zones would be blocked off to prevent exposure to personnel. Target backstops would be used in case the laser misses the target.

Air Operating Environment

The accidental release of laser chemicals onboard an aircraft during flight would be highly unlikely. The accidental release of chemicals inside the aircraft during flight would not endanger the flight crew because the aircraft would include a pressure bulkhead that separates the chemical storage areas from the flight crew area. This pressurized bulkhead would ensure that any laser emissions would not penetrate the inhabited portion of the aircraft. Chemicals could also be jettisoned to minimize the amount released inside the aircraft.

Flight test activities would be configured so that reflected lasers would be contained within range boundaries. Exposure to a reflected laser beam would likely be very short, less than 0.01 seconds in duration and would not impact health and safety. (U.S. Air Force, 1997a, as referenced in MDA, 2003a)

Noise

Land and Sea Operating Environments

Laser activation activities would produce the same noise levels in all of the biomes considered in this PEIS. The potential for impact would depend on the specific operating location. Operation of equipment to support tests of lasers on land and sea operating environments would last for less than five minutes for each test. (U.S. Department of the Air Force, 1997b) The public and on-site personnel would be excluded from the area where the noise from this equipment would be detrimental. The size of this exclusion area would be determined using OSHA limit for noise exposure.

High noise levels between 110 and 134 dBA are associated with the pressure recovery system during activation of the laser. All personnel who could be affected would be evacuated from the area for their protection or required to wear appropriate hearing protection.

Air Operating Environment

Activation of the laser on an air platform would take place at an altitude of approximately 12,192 meters (40,000 feet), and noise resulting from this activation would not affect ground level noise.

Transportation

Land and Sea Operating Environments

Air traffic is the transportation mode that might be affected by the activation of lasers. The use of lasers from land and sea platforms has the potential to impact the use of airspace if the laser beam were directed upwards.

Air Operating Environment

The use of lasers from air platforms could also impact the use of airspace. The impacts on airspace are discussed above. These impacts would be the same in all of the biomes considered in this PEIS.

Water Resources

Land Operating Environment

Chlorine released by the operation of the COIL would react with water vapor in the atmosphere to produce hydrochloric acid. Hydrochloric acid absorbed by surface waters would cause a temporary pH change such that any alteration of the water's pH would be almost imperceptible. (U.S. Department of the Air Force, 1997b)

In areas where precipitation is heavy, catchment basins are small, and stream gradients are steep hydrochloric acid would pass quickly out of stream drainages. (FAA, 1996) Ocean waters would not be significantly affected by changes in pH due to sea water's ability to readily neutralize acid.

Usually the chlorine exhaust cloud would be highly dispersed before coming into contact with surface waters and would become dilute hydrochloric acid upon mixing with water. Under rainy or humid conditions, chlorine could be concentrated spatially or locally in nearby ground and surface water sources. This could occur in the Arctic Tundra, Sub-Arctic Taiga, Deciduous Forest, and Mountain Biomes. In addition, hydrochloric acid could be produced in the Sub-Arctic Taiga, Chaparral, Savanna, and Grasslands Biomes when cool and humid conditions exist during laser activation activities. The strong winds in the BOA would support the rapid dispersion of emissions. Given the dry conditions in the Desert Biome it is unlikely that chlorine would be converted to hydrochloric acid. The Tropical Biome is generally humid but the temperatures do not cool enough to convert the chlorine produced as a result of laser activation to hydrochloric acid.

Hydrochloric acid deposition in surface waters may cause temporary increases in water acidity. Once deposited, hydrochloric acid would be diluted and dispersed by the receiving waters. Therefore, hydrochloric acid emissions would have minimal impacts on water pH levels and would not be considered harmful.

Sources of potential ground water contamination are spills of cooling water or stored chemicals and/or leaks from the chemical waste and sludge tanks. Accidental releases of spent laser chemicals would be contained in accordance with site-specific spill plans that minimize impacts on water resources.

In the case of an accidental fire, liquid and solid laser chemicals would either be consumed or contained. Chemicals consumed by the fire would be released as gases and would not impact water resources. Remaining laser chemicals would be contained by spill prevention and control measures, and would be removed and disposed in accordance with standard procedures.

Ground testing of ABLs would use vacuum and scrubbing equipment that would result in hazardous wastewater that would need to be treated and disposed in accordance with applicable regulations.

Air Operating Environment

Activation of lasers from an air platform would occur at an altitude of approximately 12,192 meters (40,000 feet), which is higher than the mixing height. Emissions would be dispersed by wind and diluted in the atmosphere and would not impact surface water resources.

Sea Operating Environment

Impacts from laser activation during sea-based operations would be similar to those described above for land operations. The addition of hydrochloric acid to the ocean from the operation of the COIL would cause a slight increase in acidity of waters in the immediate vicinity of the contact point. However, saltwater tends to readily neutralize acid and the continual movement of waves further disperses and dilutes the chemicals. Therefore, significant acidification would not occur in the ocean.

4.1.1.2 Weapons - Interceptor*s*

As described in Exhibit 4-3, the analysis for interceptors is based upon impacts from prelaunch, launch/flight, and postlaunch activities.

Air Quality

Prelaunch Activities

For pre-fueled liquid propellant boosters and solid propellant boosters, prelaunch activities, such as elevating the booster to the launch angle and attaching fins to the booster, would not significantly impact air quality in any of the biomes considered in this PEIS.

For non-pre-fueled liquid propellant boosters, the prelaunch activity with the greatest potential for air quality impacts is fueling. All fueling procedures would need to be approved by the site where the activity is to occur, and associated emergency response plans would need to be reviewed before beginning fueling activities. Although total oxidizer and fuel vapor emissions would vary depending on the propellant transfer equipment used and how it is assembled, it is anticipated that only very small amounts (approximately 10 grams [0.4 ounces]) of oxidizer vapors would be released to the atmosphere during the oxidizer transfer operation. A negligible amount of fuel vapors

would also be released into the atmosphere during fuel transfers. (U.S. Army Space and Missile Defense Command, 2002c)

Propellant releases, although unlikely, could occur during propellant loading or transfer due to failure of transfer equipment or valves. An analysis conducted for the *Liquid Propellant Targets Environmental Assessment* (2002) assumed a leak over a three-minute period would release up to 17 liters (4.5 gallons) of oxidizer inhibited red fuming nitric acid (IRFNA), hydrogen peroxide, or nitrogen tetroxide, or hydrazine fuel.

Boosters could be shipped to the test range with the kill vehicle attached, or the booster could be shipped separately from the kill vehicle. In either case, the fuel and oxidizer tanks would be installed in the kill vehicle at the test site. If the booster is shipped separately from the kill vehicle, the kill vehicle would be mated to the booster in a missile assembly building. These structures are commonly used for these types of activities, and no impacts to air quality would be expected from the mating and assembly process. (U.S. Army Space and Missile Defense Command, 2003)

Launch/Flight Activities

Launches of pre-fueled liquid propellant boosters would use a solid propellant gas generator as the ignition source. This solid propellant gas generator would have emissions similar to those discussed for solid propellant boosters; however, the quantities involved would be significantly smaller. The primary exhaust products of pre-fueled liquid propellant boosters are water, H_2, N_2, hydrogen fluoride, CO_2, and CO.

Emissions from the launch of pre-fueled liquid propellant boosters would have minimal impact on air quality. (Cortez III Environmental, 1996) The only HAPs produced from launches of these missiles would be from the solid propellant gas generator, which would produce approximately 0.05 kilograms (0.10 pounds) of hydrochloric acid per launch, which is much less than the Clean Air Act regulatory reporting requirement of nine metric tons (10 tons) per year. (U.S. Department of the Air Force, 1997b)

Launches of non-pre-fueled liquid propellant boosters would be started by using triethylamine and dimethylaniline as an initiator fuel. The initiator fuel would have emissions similar to those discussed for the primary exhaust products for liquid propellants. The primary exhaust products of non-pre-fueled liquid propellant boosters are CO, CO_2, H_2, N_2, and water. Emissions from the launch of non-pre-fueled liquid propellant boosters would have minimal impact on air quality.

The primary exhaust products of solid propellant boosters are HCl, CO, NO_X, and aluminum oxide (Al_2O_3). HCl and CO emissions are gases and Al_2O_3 is emitted as particulate. CO and NO_X emissions are further oxidized to CO_2 and NO_2 due to the high temperatures experienced during launch; however, the quantities released from a single

test event are not expected to contribute to localized accumulation of greenhouse gases. Gaseous HCl produced by launches of solid propellant boosters combines with water in the atmosphere to create hydrochloric acid aerosol, which may contribute to the formation of acid rain. This is a particular concern in high precipitation areas or humid biomes where moisture in the air could aid the conversion of HCl to hydrochloric acid. Several biomes including Arctic Tundra, Sub-Arctic Taiga, Deciduous Forest, and Mountain Biomes are considered humid. In addition, acid precipitation could be produced in the Sub-Arctic Taiga, Chaparral, and Grasslands Biomes when cool and humid conditions exist during launch activities.

As the booster proceeds through the layers of the atmosphere the impact of emissions from launch/flight activities varies depending on the propellant system used. One emission of concern produced by some liquid propellant boosters is CO, which can cause radiative heating and minor chemical reactions when emitted in the stratosphere.

Launch/flight activities can contribute to global warming through the emission of greenhouse gases. These emissions could include water vapor and CO_2. However, launch/flight activities would not contribute significantly to the total emissions of these gases, and so would not have a significant effect.

Within the stratosphere, ozone depletion is a primary concern. Ozone in the stratosphere provides a protective layer shielding the Earth from ultraviolet radiation and subsequent harmful effects. Ozone may be depleted through complex reactions with chlorine, Al_2O_3, and NO_X.

Solid propellant boosters emit HCl through high temperature afterburning reactions in the exhaust plume, which could partially be converted to atomic chlorine and molecular chlorine (Cl and Cl_2). These active forms of chlorine can contribute to localized ozone depletion in the wake of the booster. The USAF atmospheric interceptor technology (*ait)* vehicle may be representative of solid propellant boosters that would be used as part of the BMDS. The *ait* would spend approximately 25 seconds in the stratosphere at an altitude between 15 and 40 kilometers (9 and 25 miles). The first stage of the *ait* would deposit approximately 181 kilograms (400 pounds) of HCl and approximately 249 kilograms (550 pounds) of combined Cl and Cl_2 between an altitude of 15 kilometers (9 miles) and 34.6 kilometers (21.5 miles). This represents less than 14 kilograms (30 pounds) of active chlorine being distributed per kilometer of altitude traveled by the test vehicle. The second stage of the *ait* would contribute a total of approximately 3 kilograms (6 pounds) of HCl, Cl, and Cl_2 between ignition and 40 kilometers (25 miles) altitude. It is estimated that less than one pound per kilometer of altitude of the active forms of chlorine would be emitted by the second stage. Due to the large air volume over which these emissions would be spread, and because of rapid dispersion by stratospheric winds, the active chlorine from launches would not contribute to significant localized ozone depletion.

The emission of Al_2O_3 has been the subject of study with respect to ozone depletion. Al_2O_3 is emitted as solid particulates that may serve as sites for atmospheric chemical reactions. The studies (Molina, 1996, as referenced in U.S. Department of the Air Force, 1997a) indicate that Al_2O_3 can activate chlorine. The exact magnitude of ozone depletion that can result from a build-up of Al_2O_3 over time has not yet been determined quantitatively, but appears to be insignificant based on existing analysis.

Exhaust from the first stage of the USAF *ait* vehicle is approximately 27 percent by weight Al_2O_3, and the second stage exhaust is 35.4 percent Al_2O_3 by weight. The total amount of Al_2O_3 deposited between an altitude of 15 and 40 kilometers (9 and 25 miles) by each USAF *ait* flight is approximately 535 kilograms (1,180 pounds) from the first stage and 38 kilograms (83 pounds) from the second stage. The Al_2O_3 emitted during *ait* flight is in the form of smooth particles with sizes varying in diameter from less than one micron to ten microns. (Beiting, 1997, as referenced in U.S. Department of the Air Force, 1997a) Depending on the altitude where these particles are emitted, they may diffuse out of the stratosphere over a period of weeks to a few years. The particles would participate in reactions that may cause ozone depletion during the time that they stay in the stratosphere. (Molina, 1996 and Jackman, 1996, as referenced in U.S. Department of the Air Force, 1997a) The Al_2O_3 solid particles would have the potential to contribute to ozone-depleting reactions while in the stratosphere but because of the large air volume in the stratosphere and rapid mixing, they would not cause significant localized effects on stratospheric ozone depletion.

NO_X is produced during high temperature reactions known as afterburning in the exhaust plume of solid propellant boosters. As the temperature of the exhaust decreases with increasing altitude, less NO_X is formed. For the USAF *ait*, the first stage afterburning production of NO_X is nearly stopped before the vehicle reaches the stratosphere. The total NO_X deposited in the stratosphere is approximately two kilograms (four pounds) from the USAF *ait* first stage and less than 0.5 kilograms (one pound) from the second stage. Stratospheric winds would disperse these quantities rapidly; therefore, no significant effect on ozone depletion would be expected from these emissions. (Molina, 1996, as referenced in U.S. Department of the Air Force, 1997a)

Land and Sea Operating Environments. Because the booster is moving away from the point of launch, only a small portion of the launch exhaust would be emitted near the launch area. In general, biomes with moderate to high winds experience less concentration of air emissions because the winds tend to disperse the ground level emissions. These biomes may include: Deciduous Forest, Chaparral, Desert Biomes, and the BOA. Other biomes including the Arctic Tundra, Sub-Arctic Taiga, Grasslands, Tropical, Mountain, and Savanna may experience higher localized concentrations of air emissions although this would depend on the site-specific conditions.

Launch activities would not be expected to bring any new stationary emission sources to the launch area; therefore, new permits or changes to existing air permits would not be required. If new stationary emission sources were introduced into the region, it is possible that additional permits or changes to existing air quality permits would be required.

Kill vehicles could use either solid or liquid propellants. The liquid propellants likely to be used on the kill vehicle are hypergolic propellants, which would be used in small quantities. Because the launch/flight of kill vehicles is not initiated until the vehicle is high above the Earth's surface, emissions released from the kill vehicle would occur above the troposphere (10 kilometers [6.2 miles]) and therefore, would not impact ground-level air quality.

Air Operating Environment. Launches of pre-fueled and non-pre-fueled liquid and solid propellant boosters from air-based platforms would have less impact on ground-level air quality than launches from land or sea platforms because these launches would produce air emissions at a higher altitude. Using this type of operating environment, the rocket motor would be ignited at an altitude from 1.5 to 6 kilometers (0.93 to 3.7 miles). At this altitude, the booster would be ignited in the troposphere (extending to 10 kilometers [6.2 miles] above the surface of the Earth). Pollutants above the troposphere (and therefore, above the mixing layer) do not significantly impact ground-level air quality. The mixing layer allows for vertical "stirring" of air masses, which aids in the dilution of pollutants before they are slowly transported to ground level.

Postlaunch Activities

The impacts of postlaunch activities have been separated into two discussions below – one for air quality impacts when launch debris or residual propellants hit land and the other when these fall into water.

Launch Debris Hitting Land. The amount of residual propellant in the booster when it hits the ground would depend on several factors including how much propellant was in the booster at launch and how far the booster traveled during the mission. The amount of residual IRFNA in a pre-fueled liquid propellant booster could vary from 12 to 343 kilograms (26.5 to 756 pounds) and the amount of residual unsymmetrical dimethyl hydrazine could vary from 14 to 123 kilograms (31 to 271 pounds). A non-pre-fueled liquid propellant booster could impact the ground with approximately 265 liters (70 gallons) of fuel and approximately 473 liters (125 gallons) of oxidizer remaining. The residual propellants could burn upon impact, or one or both propellants could be released to the atmosphere without burning. (Cortez III Environmental, 1996)

If the propellants burn upon impact, short-term impacts to air quality would occur. The ground-based booster impact areas would be isolated from inhabited areas and would be

evacuated prior to a launch; therefore, any exceedances of the NAAQS or exceedances of health-based criteria would not endanger the public. The remote location of the impact area would allow time and distance sufficient to disperse fumes to a non-hazardous level. It is not anticipated that combustion of the propellant(s) would result in air quality impacts beyond the immediate impact site.

If the residual propellants were released to the atmosphere without burning, the IRFNA is likely to be volatilized as NO_X and nitric acid. Observations of launches of pre-fueled liquid propellant boosters at WSMR indicate that a brown cloud has been observed immediately after impact. (Wilson, 1999, as referenced in Cortez III Environmental, 1996) This cloud is likely produced by IRFNA converting to NO_X, which can induce severe irritation to the eyes, skin, and mucous membranes and can lead to suffocation. Unsymmetrical dimethyl hydrazine is a known carcinogen that can react with oxygen and release toxic fumes of NO_X if released to the air without combusting. These releases have been studied to dissipate below hazardous levels within 24 hours and to be undetectable after a period of six months. (Wilson, 1991, as referenced in Cortez III Environmental, 1996) Hydrogen peroxide and hydrocarbons would dissipate when exposed to air. Nitrogen tetroxide if released to the air without combusting would be converted to gaseous form.

Residual propellant from solid propellant boosters would likely continue to burn until expended if encased; however, if released from the motor casing, it is possible that solid propellant would not burn completely. This combustion would have a minor impact on air quality. There is a possibility that the burning solid propellant if encased could start a fire on the ground. The resulting fire could impact air quality in the area immediately surrounding the impact area.

During a mission involving a successful intercept, the kill vehicle would be destroyed and small pieces of debris would impact the Earth’s surface. The small pieces of debris may temporarily serve as sites for chemical reactions in the Earth’s atmosphere until the debris reaches the ground. However, the impacts to air quality would be minimal.

If the propellants in the kill vehicle were released to the atmosphere in an impact, they would either burn up, or one or both propellants could be released to the atmosphere and evaporate. Impacts from either scenario would be similar to those discussed above for propellants released from liquid propellant boosters.

Launch Debris Hitting Water. The impacts to air quality from postlaunch activities resulting in boosters and kill vehicles hitting the ocean would be similar to, but less than those impacts discussed above for boosters and kill vehicles hitting land because the residual liquid propellants would be released into the ocean rather than the air. Impacts to water quality from a direct release to water are described in the hazardous waste

section. Solid propellant, if still in the casing, might continue to burn for some time even under water. However, this would create minimal impacts to air quality.

Airspace

Prelaunch Activities

There would be no impact on airspace from prelaunch activities, including, fueling, evacuations and clearances, and road closures, because these activities do not physically interfere with navigable airspace or affect airspace scheduling.

Launch/Flight Activities

Close coordination with the appropriate FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impacts on airspace use and scheduling for launches from all operating environments in all of the biomes considered in this PEIS. Launches of boosters and kill vehicles would require coordination with current aeronautics and space activities within the airspace associated with launch sites. Launch, flight, and impact of boosters and kill vehicles would occur in designated areas of cleared airspace.

Land Operating Environment. Although launches of interceptors might require closure of some airspace and would, therefore, impact the amount of available airspace, this type of activity is considered routine at many military installations and would not constitute a significant impact. Aircraft transiting the area would be notified of any necessary rerouting requirements before departing their originating airport and would thus be able to take on any additional fuel before takeoff to avoid the affected area. Launches would be scheduled such that they would not affect airborne activities outside the airspace complex(es) where they are to occur, and would not interfere with any low- or high-altitude en route airways or jet routes use by civilian or private airports in the vicinity of the launch site.

In addition, before conducting an operation that is potentially hazardous to non-participating aircraft, Notices to Airmen (NOTAMs) would be established in accordance with range safety procedures. To satisfy airspace safety requirements, the responsible official would obtain approval from the FAA, prior to conducting the launch. Provisions also would be made for surveillance of the affected airspace by radar and patrol aircraft prior to booster launch. Safety regulations dictate that hazardous operations are suspended when any non-participating aircraft enters any part of the hazard area. Operations would resume when the non-participating entrant has left the area or a thorough check of the suspected area has been performed. For these reasons, no adverse impacts to airspace are expected from ground launches.

Air Operating Environment. Within minutes after launch, the booster would be propelled to an altitude of several hundred thousand feet, well above the typical altitudes used by commercial aircraft. The launches, flight trajectory, and ground impacts would occur at sufficient distance and altitude to be virtually unnoticed by local, non-military flying activities. Other impacts to airspace from launches of boosters from air operating environments would be as described for launches from land operating environments.

Sea Operating Environment. Potential impacts to airspace from launches of boosters from sea platforms would be minimized by coordination between airspace complexes. Procedures would be similar to those for launches from land and air operating environments. If the sea operating environment were positioned in the BOA, potential impacts would be further minimized because airspace over the BOA is not heavily used.

Establishing restricted areas would marginally reduce the amount of navigable airspace in the BOA, but because the airspace is not heavily used, the impacts to controlled and uncontrolled airspace would be minimal. If possible, the sea environment would be positioned to avoid the en route airways and jet routes that cross the BOA. Therefore, no significant impacts to the over-water airways and jet routes would be expected from any type of missile launched from a sea operating environment.

Postlaunch Activities

Impacts of postlaunch activities on airspace are discussed below addressing postlaunch debris recovery on land and in water.

Launch Debris on Land. If necessary, helicopter retrieval of debris, from boosters or kill vehicles deposited on land would be within the boundaries of the designated impact area and therefore, within the airspace complex. Debris retrieval would have no impact on navigable airspace or airborne activities outside the restricted airspace complex.

Launch Debris in Water. If debris from boosters or kill vehicles falls into water, MDA would not likely recover the debris. Therefore, helicopters and other equipment would not be used, and no impacts to airspace would be expected. If it were necessary to recover debris from water for a specific test, the impacts of debris retrieval would be analyzed as appropriate.

Biological Resources

Prelaunch Activities

There would be no impacts to biological resources from prelaunch activities for pre-fueled and solid propellant boosters and kill vehicles. For non-pre-fueled liquid propellant boosters, no more than a few grams of propellant would be released during

normal fueling operations and appropriate responses to leaks and releases would be implemented to minimize the hazard to biological resources. All fueling would be conducted using impermeable barriers appropriate for this type of activity, which would minimize the potential for a spill to impact biological resources.

Launch/Flight Activities

The presence of launch-related personnel prior to launch, noise associated with launch, and launch emissions all have the potential to impact biological resources during launch.

Informal observation at several launch facilities indicates that the increased presence of personnel immediately before a launch tends to cause birds and other mobile species of wildlife to temporarily leave the area prior to the launch. This would effectively reduce the effects of sound, launch emissions, and heat on these animals. However, personnel associated with the launch would comply with USFWS, other regulatory agency, and relevant site-specific procedures to protect biological resources including species of special concern.

The effects of noise on wildlife can be categorized as either auditory or non-auditory. Auditory effects would consist of direct physical changes, such as eardrum rupture or temporary threshold shift (temporary hearing loss). Non-auditory effects could include stress, behavioral changes, and interference with mating or foraging success. The effects of noise on wildlife vary from serious to no effect in different species and situations. Animals can also be sensitive to noises in some situations and insensitive to the same noises in other situations. (Larkin, 1996) Behavioral responses to noise also vary from startling to retreat from favorable habitat.

Launches would be relatively infrequent events. Disturbance to wildlife would be brief and would not be expected to have a lasting impact nor a measurable negative effect on migratory bird populations. Wildlife would resume feeding and other normal behavior patterns after a launch is completed. Specifically, a 1982 study by Stewart found that birds exposed to 115.6 to 145.5 dBA short intensity noise events returned to their nests within 2 to 10 minutes after the disturbance. (Stewart, 1982, as referenced in Manci, et al., 1988) In addition, a 1980 study by Jehl and Cooper used shotgun blasts and explosives to simulate short duration noise events and found that nesting birds returned within 30 seconds of the disturbance. (Jehl, J.R and C.F. Cooper, 1980, as referenced in Manci et al, 1988) Wildlife driven from preferred feeding areas by aircraft or explosions usually return soon after the disturbance stops, as long as the disturbance is not severe or repeated. (FAA, 1996) Foraging birds would be subjected to increased energy demands if flushed by the noise, but this should be a short-term, minimal effect.

Video camera observations of a wood stork colony located 0.8 kilometer (0.5 mile) south of the Space Shuttle launch pad at Kennedy Space Center showed the birds flew south

away from the noise source and started returning within two minutes, with a majority of individuals returning in six minutes. (NASA, 1997, as referenced in U.S. Army Space and Missile Defense Command, 2002c) This rookery continues to be used successfully, even though it has received peak noise levels of up to 138 dB. (American Institute of Aeronautics and Astronautics, 1993, as referenced in U.S. Army Space and Missile Defense Command, 2002c) Birds roosting within 250 meters (820 feet) of Titan launch complexes at Cape Canaveral Air Force Station have shown no mortality or reduction in habitat use.

Fixed wing aircraft and helicopters are often used for routine flights around the Arctic Tundra Biome. These aircraft noises have been shown to produce sounds that are disturbing to seabirds. (Fjeld et al., as referenced in Chardine and Mendenhall, 2003) Breeding murres and eiders appear to be sensitive to this type of disturbance. Murres do not build nests but rather incubate their eggs on their feet; therefore, overflight noises may produce panic flights, leading to egg loss.

During breeding and nesting periods birds may be less likely to flush from their nests for long periods of time. Monitoring studies of birds during the breeding season indicate that adults respond to Space Shuttle noise by flying away from the nest, but they return within two to four minutes.

Noise associated with launches may disrupt critical nesting and migratory points for birds in the Deciduous Forest and Chaparral Biomes, which are common migration corridors for many species. Efforts at reducing noise interference are already underway to protect the endangered Red-Cockaded Woodpecker in the Southeast U.S., where it is estimated that nearly a quarter of the remaining Red-Cockaded Woodpecker population resides on 16 military installations. (Delaney et al., 2002) Birds located in other biomes may also be impacted by launch activities and the extent of impact would be determined based on site-specific considerations.

Noise level thresholds for impact to marine life in general and marine mammals in particular, are currently the subjects of scientific studies. Because different species of marine mammals have varying sensitivities to different sound frequencies, and the species may be found at different locations and depths in the ocean, it is difficult to generalize sound impacts to marine mammals from booster launches. Should consensus emerge from scientific analyses about the effects of noise on underwater marine mammals, it would be possible to predict the consequences of particular sonic boom contours on marine mammals in the area.

According to analysis provided in the U.S. Navy’s *Point Mugu Sea Range Environmental Impact Statement (EIS)/Overseas EIS* (2002), brief transient sounds such as sonic booms are unlikely to result in significant adverse effects to pinnipeds or whales in the water. Pinnipeds seem tolerant of noise pulses from sonic booms, although reactions may occur.

Temporary displacement, less than one or two days, is considered a less than significant impact. Baleen whales (humpback, gray, and bowhead) have often been observed behaving normally in the presence of loud noises, such as distant explosions and seismic vessels. Most gray and bowhead whales show some avoidance of areas where these noises have pressures exceeding 170 dB. (U.S. Department of the Navy, 2002, as referenced in U.S. Army Space and Missile Defense Command, 2003)

Launch emissions from pre-fueled and non-pre-fueled liquid propellant boosters would have the potential to impact biological resources, but the impact would be minimal. HCl and Al_2O_3 emitted during launches of solid propellant boosters can harm plants and wildlife. Studies indicate that low-level, short-term exposure to HCl, as would be the case in booster launches, would not cause significant damage to vegetation or wildlife. Animals and birds passing through the exhaust plume may be exposed to levels of HCl that would irritate their eyes and respiratory systems. (FAA, 1996, as referenced in U.S. Army Space and Missile Defense Command, 2002a) Al_2O_3 has a very low toxic potential. HCl and Al_2O_3 do not bioaccumulate; and therefore, no effects on the food chain would be expected. Surface water including wetlands could be impacted by the presence of hydrochloric acid, which could lower the pH and have a negative effect on species relying on the wetlands.

Land Operating Environment. Launch activities from land-based operations that take place in previously disturbed areas would not be expected to adversely affect plant species. Launch areas are typically cleared of all vegetation and either covered with a layer of course gravel or left bare. (Cortez III Environmental, 1996) However, fire from a launch mishap at the launch site could impact plant species that may be present. Any fire would be extinguished quickly, where possible, minimizing impacts to vegetation remaining in the area. The risk of fires from launch activities is particularly prevalent in the Chaparral and Tropical Biomes, which are prone to wildfires.

Sea Operating Environment. Pollutants would be present in the exhaust plume from boosters launched from sea platforms that could threaten wildlife near the point of the sea launch. However, these pollutants would be produced in trace quantities and would not have measurable effects on biological resources.

Postlaunch Activities

Impacts of launch debris on biological resources are discussed below on land versus those impacts of debris falling into water.

Launch Debris Hitting Land. The amount of ground disturbed for each booster or kill vehicle impact would be less than 0.2 hectares (0.5 acres). (U.S. Army Space and Missile Defense Command, 2002c) Restoration of impact sites that are currently used for booster or kill vehicle impacts, if deemed necessary, would be conducted on a case-by-case basis

in coordination with the appropriate officials. Because threatened and endangered plant and animal species tend to be widely scattered and occupy small surface areas, the probability of a booster striking an individual of a federally listed, threatened, or endangered species is remote.

New impact areas for boosters or kill vehicles could be created for specific missions. Selection of a new impact area would be coordinated with the appropriate range personnel to avoid or minimize potential harm to protected species. Effects to biological resources from impacts on a new area would be similar to those described above for impacts on existing areas.

Recovery of booster and kill vehicle debris, if required, would be conducted in accordance with the launch site's existing procedures. These procedures outline steps to be taken to avoid known sensitive areas. Off-road vehicle recovery operations would be used only if necessary and would be coordinated with the appropriate responsible officials. Recovery by vehicle would be limited to the minimum number of vehicles necessary to complete the operation. If necessary, light-lift helicopters could be used to recover debris in rough terrain. Aircraft, particularly helicopters, are loud and produce sounds that might disturb wildlife. Low altitude helicopter flights, which are known to cause panicky reactions in some wildlife species, would be intermittent, would involve gradual descents when necessary, and would then return to altitudes that would avoid further startling effects.

In the unlikely event of flight termination or catastrophic missile failure, the impact of debris on land areas may damage vegetation and wildlife. In the case of flight termination or missile failure, debris and residual propellant could result in a fire that could damage vegetation and wildlife. However, impact areas would generally be cleared of vegetation, minimizing the potential for impact to biological resources due to fires. Hazardous debris, if any, would be recovered as quickly as possible.

Launch Debris Hitting Water. Debris falling into water has the potential to cause non-acoustic effects to biological resources. These effects include physical impact by falling debris, entanglement in debris, and contact with or ingestion of debris or propellants.

Boosters hitting the ocean surface would impart a considerable amount of kinetic energy to the ocean water upon impact. Interceptors would hit the water with speeds of 91 to 914 meters (300 to 3,000 feet) per second. The shock wave from their impact with the water would be similar to that produced by explosives. Depending on the water depth, strong waves from the impact may detach kelp strands from the sea floor. During successful missions, boosters would impact in the deep open ocean waters. At close ranges, injuries to marine mammal internal organs and tissues would likely result.

However, the density of marine species including marine mammals generally decreases, and the corresponding probability of impact decreases, as the distance from the shore increases. Injury to any marine mammal by direct impact or shock wave impact would be extremely remote (less than 0.0006 (6 in 10,000) marine mammals exposed per year). (U.S. Department of the Navy, 2002b)

Impacts to marine biological resources from releases of residual propellants from liquid propellant boosters would not be significant. The natural buffering capacity of sea water and the strong ocean currents would neutralize the reaction to any release of the liquid propellants. Impacts to water quality from a direct release to water are described in the hazardous waste section.

The parts of solid rocket motor propellant expelled from a destroyed or exploded rocket motor that fall into the ocean would most likely sink to the ocean floor at depths of thousands of meters. At such depths, the propellant parts would be located away from feeding marine mammals. (U.S. Department of the Navy, 1998 as referenced in U.S. Army Space and Missile Defense Command, 2003) Therefore, marine animals would not be impacted from ingesting the solid propellant.

Geology and Soils

Prelaunch Activities

There would be no impacts to geology and soils from prelaunch activities for pre-fueled liquid and solid propellant boosters. Fueling of non-pre-fueled liquid propellant boosters would be conducted using appropriate impermeable barriers. (U.S. Army Space and Missile Defense Command, 2002c) Adherence to these procedures would minimize the potential for spills and any impacts to soils.

Launch/Flight Activities

Impacts to geology and soils are discussed separately below for land, sea and air operating environments.

Land Operating Environment. Potential geology and soils impacts from ground launches would be minor. Emissions that occur above the mixing height or above the troposphere would not affect geology and soils.

Soils that are strongly leached (removed of nutrients, including calcium) and are therefore acidic could be adversely affected by the addition of hydrochloric acid produced when HCl interacts with water in humid biomes further increasing soil acidity. This could occur in the Arctic Tundra, Sub-Arctic Taiga, Savanna, Mountain and parts of the Deciduous Forest, and Tropical Biomes.

The intensity of the acidic effect is a function of the amount of calcium carbonate in the soils. Calcium carbonate in some soils including those in the Grasslands and Deciduous Forest and some limestone rich portions of the Tropical Biome have nearly unlimited buffering capacities and would likely prevent emissions produced from solid boosters from affecting geology and soils. (EPA, 2003g) Therefore, no significant impacts to geology and soils would be expected.

The Chaparral and Desert Biomes are unlikely to produce hydrochloric acid as a result of launches of solid propellant boosters and therefore soils in these biomes are unlikely to be affected by increased acid deposition. Although overall impacts to geology and soils from launch activities are expected to be minor, in areas where launches have not previously occurred, such as the U.S. Mountain Biome, the exhaust ground cloud could impact areas not previously disturbed by launch activities. The specific impacts to these areas would need to be analyzed as appropriate.

Air Operating Environment. Impacts to geology and soils from air-based launches would be minor because ignition of the booster would occur several thousand feet above ground level. Emissions from air launches of boosters would have a smaller effect on geology and soil resources than land launches because the emissions would be at a greater altitude and would, therefore, be subject to greater dispersion and dilution prior to reaching the ground.

Sea Operating Environment. No impacts to geology and soils would be expected from launches from sea-based platforms due to the depth of the ocean in areas from which sea launches would operate.

Postlaunch Activities

Impacts to geology and soils from launch debris hitting land versus falling into water are discussed separately below.

Launch Debris Hitting Land. The debris from boosters and kill vehicles could physically impact the ground surface and overlying soils, but there would be no impact expected on geologic resources. Land surface damage from debris would be variable and determined by impact energy, soil compressibility, presence of water, and altitude from which the debris fell. (U.S. Army WSMR, 1998) The impact of the debris may result in ground depressions up to six meters (20 feet) deep. The extent of immediate physical disturbance to the soil from debris impact is likely to be less than 0.2 hectares (0.5 acres).

Debris recovery, if required, would be limited to necessary vehicles and off-road access would follow the same entry route, to the extent possible, to complete the recovery operations with minimal disturbance to soils. (U.S. Army WSMR, 1998)

Residual propellants may be released upon booster or kill vehicle impact. If the propellants burn on impact, fire containment activities could also cause minor impacts to the soil. If vegetation were damaged, then wind and water erosion could both increase.

If the residual IRFNA or unsymmetrical dimethyl hydrazine in a pre-fueled liquid propellant booster do not explode or burn at impact, then they would most likely be deposited on the ground. The IRFNA would volatilize into the atmosphere. Hydrazine fuel would slowly dissipate from surface soils within 24 hours. Hydrazine fuels buried in an impact crater created by the debris would dissipate over several months and would not significantly impact geology or soils. (Cortez III Environmental, 1996)

If the residual propellants from non-pre-fueled liquid propellant boosters do not explode or burn at impact, then they would most likely be deposited on the ground. The nitrogen tetroxide oxidizer would volatilize into the atmosphere. Any residual nitric acid would react with alkaline soils resulting in the deposition of nitrates that would act as a fertilizer and would not appreciably affect soils. Hydrogen peroxide oxidizer deposited on the ground would decompose into water and oxygen within several hours. Kerosene or JP-8 fuel deposited on the ground would be absorbed by the soil. Personnel at the debris impact site would follow standard operating procedures to determine whether soil remediation or removal and treatment and disposal actions are required.

Launch Debris Hitting Water. No impacts to geology and soils would be expected from debris falling into the ocean due to the depth of the ocean where debris would impact. Inert pieces of debris would be deposited in the ocean and would consist of aluminum, steel, graphite composite, plastic, ceramic, and rubber. These materials would likely sink to the ocean floor; however, they would be unlikely to impact geology and soils in ocean areas.

Hazardous Materials and Hazardous Waste

Prelaunch Activities

The types of hazardous materials used and waste generated during prelaunch, launch/flight, and postlaunch activities would be similar to those currently used and generated at military installations. Accidental releases of hazardous materials would be contained in accordance with site-specific spill plans. Temporary storage tanks and other facilities for the storage of hazardous materials would be located in protected and controlled areas. Activities would be conducted to comply with site-specific spill prevention, control and countermeasure (SPCC) plans, such as an Oil Discharge Prevention and Contingency Plan and a Storm Water Pollution Prevention Plan (SWPPP). (U.S. Army Space and Missile Defense Command, 2002d) Any spill of a hazardous material or hazardous waste that might occur could be quickly remediated in

accordance with a Storm Water Pollution Prevention Plan and SPCC plan that would be developed for each site.

Should it become necessary to remove the propellants from a pre-fueled liquid propellant booster, the propellant would be drained into empty bulk liquid propellant containers stored at the fueling location. (U.S. Army Space and Missile Defense Command, 2002c) The defueled oxidizer tank would be flushed with deionized water, and the fuel tank would be flushed with ethyl alcohol. The booster would be transported back to the missile assembly building for reuse or returned to an appropriate facility. Emergency response planning would be incorporated into the operations requirements to minimize any impacts due to an unplanned release of hazardous materials. Therefore, no significant impacts would be expected.

Non-pre-fueled liquid propellant boosters could be fueled at the launch location, provided there is sufficient space, or at a fixed, permanent facility. Fuel and oxidizer would be transported separately to the loading location and loaded at different times. Spill containment for the propellant transfer operation could be provided by a temporary containment system that is impervious to each particular fuel and oxidizer. One set of temporary containment barriers would be used for fuel, and a second set would be used for oxidizer. (U.S. Army Space and Missile Defense Command, 2002c) After completion of the transfer operations, the transfer equipment would be flushed to decontaminate it. Flushing the fuel transfer system would generate approximately 208 liters (55 gallons) of ethyl alcohol with approximately 40 grams (1.4 ounces) of fuel in solution. Flushing the oxidizer transfer system with deionized water would generate approximately 4,164 liters (1,100 gallons) of neutralized deionized water and oxidizer rinsate (less then 1 percent) and would result in the release of approximately five grams (0.2 ounces) of nitric oxide to the atmosphere. The material generated from flushing the propellant transfer systems would be handled as hazardous waste and would be disposed via appropriate procedures using permitted disposal facilities. Although propellant quantities and fueling systems have not been defined for all non-pre-fueled liquid propellant boosters, it is anticipated that similar materials would be generated when flushing hydrogen peroxide oxidizer and hydrocarbon fuel. Flushing nitrogen tetroxide oxidizer would involve similar methods and materials generated as IRFNA.

Should it become necessary to remove the propellants from the non-pre-fueled liquid propellant booster, the propellant would be transferred into empty bulk liquid propellant containers stored at the fueling location. (U.S. Army Space and Missile Defense Command, 2002c) The propellant containers would then be transported to the respective propellant storage areas for reuse in the next mission. The defueled oxidizer tank would be flushed with deionized water and the fuel tank would be flushed with ethyl alcohol as described above. The booster would be transported back to the missile assembly building for reuse or returned to an appropriate facility.

The fuel and oxidizer tanks in kill vehicles would be installed at the test site. Spill containment and propellant removal procedures would be similar to those described above for non-pre-fueled liquid propellant boosters.

There would be no impacts from prelaunch activities for solid propellant boosters.

Launch/Flight Activities

Launch activities would produce the same hazardous materials and hazardous waste in all biomes considered in this PEIS. Launches would potentially increase the hazardous waste generated at the launch sites. However, this increase in hazardous waste would not overburden the various facilities' hazardous waste management programs, and only minimal impacts would be anticipated. During a nominal launch there would be no hazardous materials or hazardous waste impacts from the launch/flight of boosters or kill vehicles.

Postlaunch Activities

Impacts from hazardous materials and hazardous waste launch debris are addressed separately below on land versus in water.

Launch Debris on Land. Debris from boosters and kill vehicles and residual propellant would be handled in accordance with the appropriate spill contingency plan for the launch location/debris impact site. These plans establish responsibility, outline personnel duties, and provide resources and guidelines for use in the control, clean up, and response to spills.

Entry to the debris impact site would be restricted to trained hazardous material response personnel until the area is determined to be safe. All debris would be tested to determine if it is hazardous waste. Hazardous waste would be disposed via permitted procedures. For a nominal flight, liquid propellant boosters would contain unburned propellant upon impact within the planned impact area. The amount of propellant remaining in the booster would vary depending on the particular mission objectives (i.e., distance flown and fuel burned).

During nominal flights of solid propellant boosters, most of the solid propellant would be expended. Debris would include structural material and batteries. These materials would be inert and would not have any significant impacts. Flight termination or catastrophic failure of the booster would result in the deposition of structural material and battery debris and any residual propellant. Some of the potentially hazardous material contained in the batteries or propellants would likely be consumed during the termination or failure. It is not expected that the remaining debris would pose a significant impact.

Launch Debris in Water. NASA has conducted evaluations of the effects of missile systems deposited in sea waters. The studies determined that materials would be rapidly diluted, and except for areas in the immediate vicinity of the debris, would not be found at concentrations identified as causing any adverse effects. This applies to debris deposited either as a result of successful or unsuccessful intercepts, or due to in-flight malfunction or flight termination along the flight corridor. Eventually, all hazardous materials falling into the ocean would become diluted and would cease to be of concern. NASA determined that the release of hazardous materials aboard missiles into sea waters would not be significant. (NASA, 1973 as referenced in U.S. Army Space and Missile Defense Command, 2003) Therefore, no significant impacts to the ocean environment would be expected from postlaunch activities involving liquid propellant missiles.

During flight termination or catastrophic missile failure of solid propellant boosters, pieces of unburned propellant could be dispersed over an ocean area of up to several kilometers. Once in the water, ammonium perchlorate could slowly leach out and would be toxic to plants and animals. In freshwater at 20^{o}C (68^{o}F), it is likely to take over a year for the perchlorate contained in solid propellant to leach out into the water. (Lang et al., 2000, as referenced in U.S. Army Space and Missile Defense Command, 2003) Lower water temperatures and more saline waters would likely slow the leaching of perchlorate from the solid propellant into the water. Over this time, the perchlorate would be diluted in the water and would not reach significant concentrations. (U.S. Army Space and Missile Defense Command, 2003)

Health and Safety

Prelaunch Activities

The handling and assembly of booster components are typically accomplished within enclosed buildings. These activities would adhere to applicable laws and regulations including the Range Commanders Council Standard 321-02, which establishes limits for risk to human health and safety. These analyses would take into account installation-specific and test-specific safety tolerances (range hazard areas).

Prelaunch activities for pre-fueled liquid and solid propellant boosters would not have any impact on health and safety. All liquid propellant booster fueling procedures for non-pre-fueled liquid propellant boosters would be approved for the site where the activity is to occur, and associated emergency response plans would need to be reviewed before beginning activities to ensure protection of health and safety. Total oxidizer and fuel vapor emissions would vary depending on the propellant transfer equipment used and how it is assembled. It is anticipated that only very small amounts of oxidizer vapors would be released to the atmosphere during the oxidizer transfer operation. A negligible amount of fuel vapors would also be released into the atmosphere during fuel transfers. Exposure to liquid propellants resulting from fueling activities would be minimal. The

existing condition in several biomes would preclude fueling emissions from impacting health and safety of workers; this would be true in biomes where wind conditions would rapidly disperse emissions. Windy conditions are likely in the Sub-Arctic Tundra Biome.

Analysis conducted using the U.S. Air Force Toxic Corridor Model computer model indicated potential exceedances of health standards as shown in Exhibit 4-9. Actual hazard distances would depend on the propellant, the amount released, meteorological conditions, and emergency response measures taken. Standard operating procedures would be developed and would include personal protection equipment procedures and distances at which it would be safe to establish fueling operations area boundaries. Establishment of and adherence to these procedures would minimize the potential health and safety hazards to personnel in the unlikely event of an unplanned propellant release. The low likelihood of such an occurrence and the implementation of approved emergency response plans would limit the impact of such a release. People located at distances in excess of the exceedance distance would not be exposed to health and safety impacts from prelaunch fueling activities.

Exhibit 4-9. Potential Exceedances Due to Accidental Oxidizer or Fuel Leak to Air During Fueling Activities

Propellant	Health Standard	Standard Limit	Exceedance Distance
IRFNA	OSHA Permissible Exposure Limit (PEL)[a]	2 parts per million (ppm) (5 milligrams per cubic meter (mg/m^3))	34 meters (112 feet)
	National Institute for Occupational Safety and Health (NIOSH) Short Term Exposure Limit (STEL)[b]	4 ppm (10 mg/m^3)	20 meters (66 feet)
	Immediately Dangerous to Life and Health (IDLH)[c]	25 ppm (65.5 mg/m^3)	Not Exceeded
Hydrogen Peroxide	OSHA PEL	1 ppm (1.4 mg/m^3)	212 meters (696 feet)
	NIOSH STEL	1 ppm (1.4 mg/m^3)	212 meters (696 feet)
	IDLH	75 ppm (105 mg/m^3)	14 meters (46 feet)
Nitrogen Tetroxide	American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV)[d]	3 ppm (5.4 mg/m^3)	310 meters (1,017 feet)
	ACGIH STEL[b]	5 ppm (9 mg/m^3)	227 meters (746 feet)
	IDLH	75 ppm (135 mg/m^3)	103 meters (336 feet)
Hydrazine	OSHA PEL	1 ppm (1.31 mg/m^3)	117 meters (383 feet)

Exhibit 4-9. Potential Exceedances Due to Accidental Oxidizer or Fuel Leak to Air During Fueling Activities

Propellant	Health Standard	Standard Limit	Exceedance Distance
	ACGIH STEL	0.1 ppm (0.131 mg/m^3)	36 meters (118 feet)
	IDLH	50 ppm (65.5 mg/m^3)	Not Exceeded

Source: Modified from U.S. Army Space and Missile Defense Command, 2002c
Notes:
[a] The OSHA PEL is the level of exposure that must not be exceeded when the exposure is averaged over an 8-hour workday and a 40-hour workweek in the workplace.
[b] The NIOSH STEL (or OSHA STEL or ACGIH STEL) is the level of exposure that must not be exceeded at any time during a workday when the exposure is averaged over 15 minutes.
[c] The IDLH is the level of exposure (not time-weighted) above which it is anticipated a person would suffer life-threatening or irreversible health effects or other injuries that would impair them from escaping the hazardous environment.
[d] The ACGIH TLV is an average value of exposure over the course of an 8-hour work shift.
[e] Exceedance Distance-Average of U.S. Air Force Toxic Corridor model results for 15-minute and 30-minute averaging time and multiple stability classes.

Boosters could arrive at the test range with the kill vehicle attached, or the booster may be shipped separately from the kill vehicle. In either case, the fuel and oxidizer tanks would be installed in the kill vehicle at the test site. If the booster is shipped separately from the kill vehicle, the kill vehicle would be mated to the booster in a missile assembly building at the launch facility. These structures are commonly used for these types of activities and no impacts to health and safety would be expected from the mating and assembly process. (U.S. Army Space and Missile Defense Command, 2003)

Launch/Flight Activities

Launch activities would produce the same impacts on health and safety in all of the biomes considered in this PEIS. Potential impacts to health and safety include exposure to explosives, contact with launch debris, and exposure to noise produced during launch. Because launches would take place on facilities with restricted access, members of the public would not be exposed to these hazards.

Appropriate health and safety standard operating procedures would be developed to protect personnel. Every reasonable precaution would be taken during the planning and execution of a launch to prevent injuries.

A written procedure for all explosive activities is required and must be approved by the appropriate range authorities. Established procedures to prohibit access to restricted areas would be followed. The restricted areas are based upon the probability of potential hazards involved with malfunction during launches and would include

- The impact limit line, which sets the boundary protection line for all non-mission essential personnel;
- The launch caution corridor, an area limited to essential personnel;
- The LHA, an area around the launch point limited to essential personnel in hardened facilities; and
- The stage or booster impact area.

Impact zones for each launch would be delineated based on detailed launch planning and trajectory modeling, which would include analysis and identification of a flight corridor. Flights would be conducted when trajectory modeling verifies that launch-related debris would be contained within predetermined areas, all of which would be located away from inhabited land and populated areas.

Launch-related personnel that would be exposed to noise in excess of applicable standards including OSHA regulation 1910.95 would be required to wear appropriate hearing protection, which would reduce the noise levels to prescribed health and safety levels.

Postlaunch Activities

There is the potential for impact of debris from boosters and kill vehicles at any point along the flight corridor due to missile malfunction and/or termination of a missile flight by the FTS. The resulting debris would follow a ballistic trajectory and would impact in designated impact areas either on land or in the ocean. Because an exact point of termination cannot be determined, the potential effects footprint is determined by considering the limits of debris fallout based on destruction of a test missile at the boundaries of the acceptable flight corridor, along with additional flight time based on the time required to initiate the FTS. The possibility of debris hitting the ground or water outside the designated impact area is remote; and therefore, safety impacts of flight termination would not be significant. Debris modeling and analysis would be conducted for specific proposed activities as appropriate.

Launch Debris on Land. Procedures would be developed to establish appropriate debris recovery procedures, as necessary, and would include personal protective equipment and determination of appropriate recovery zone hazard boundaries. Therefore, no health and safety impacts would be expected from postlaunch activities.

Exhibit 4-10 indicates the results of an analysis using the U.S. Air Force Toxic Corridor Model to determine distances at which various health standards could be exceeded based on the release of residual propellant at the debris impact area. The analysis was conducted for non-pre-fueled liquid propellant boosters assuming 473 liters (125 gallons) of the remaining oxidizer and 265 liters (70 gallons) of the remaining fuel were released

to the atmosphere. People located at distances in excess of the exceedance distance would not experience impacts to health and safety from postlaunch activities.

Exhibit 4-10. Potential Exceedances Due to Accidental Oxidizer or Fuel Leak at the Booster Impact Site

Propellant	Health Standard	Standard Limit	Exceedance Distance
Inhibited Red Fuming Nitric Acid (IRFNA)	OSHA PEL	2 ppm (5 mg/m^3)	213 meters (699 feet)
	NIOSH STEL	4 ppm (10 mg/m^3)	140 meters (458 feet)
	IDLH	25 ppm (65.5 mg/m^3)	50 meters (164 feet)
Hydrogen Peroxide	OSHA PEL	1 ppm (1.4 mg/m^3)	195 meters (639 feet)
	NIOSH STEL	1 ppm (1.4 mg/m^3)	195 meters (639 feet)
	IDLH	75 ppm (105 mg/m^3)	11 meters (36 feet)
Nitrogen Tetroxide	ACGIH TLV	3 ppm (5.4 mg/m^3)	1,074 meters (3,525 feet)
	ACGIH STEL	5 ppm (9 mg/m^3)	740 meters (2,429 feet)
	IDLH	75 ppm (135 mg/m^3)	274 meters (899 feet)
Hydrazine	OSHA PEL	1 ppm (1.31 mg/m^3)	462 meters (1,515 feet)
	ACGIH STEL	0.1 ppm (0.131 mg/m^3)	123 meters (404 feet)
	IDLH	50 ppm (65.5 mg/m^3)	13 meters (44 feet)

Source: Modified from U.S. Army Space and Missile Defense Command, 2002c

Launch Debris in Water. Booster trajectories would be established to preclude potential water impacts in heavily trafficked ocean areas. Notices to Mariners (NOTMARs) would be issued as appropriate to advise mariners of the projected impact area. In the event of a flight termination, the possibility of debris impacting a sea vessel would be remote, and therefore safety impacts of flight termination would not be significant.

During flight termination or catastrophic missile failure of solid propellant boosters, pieces of unburned propellant could be dispersed over an ocean area of up to several kilometers. Once in the water, ammonium perchlorate could slowly leach out. In 1985, perchlorate was detected in wells of California Superfund sites; however, perchlorate contamination was not detected nationwide until 1997. Currently there are no Federal drinking water standards for perchlorate. The EPA has the responsibility to establish national drinking water standards and has issued draft risk assessments of perchlorate. These assessments have been criticized because it has been suggested that the findings are based on flawed scientific studies and that not all available data were considered and incorporated. Because of these controversies, the EPA, DoD, DOE, and NASA asked the National Research Council (NRC) to independently assess the adverse health effects of perchlorate ingestion from clinical, toxicological, and public health perspectives. The NRC was also tasked to review the scientific literature and findings from the EPA's 2002

draft risk assessment, *Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization*.

Although there are no Federal drinking water standards for perchlorate several states have proposed interim guidance levels or goals for perchlorate levels in drinking water. In March 2004, the State of California Office of Environmental Health Hazard Assessment established a public health goal for perchlorate in drinking water of 6 parts per billion. (California Office of Environmental Health Hazard Assessment, 2005) The NRC study considered the health impacts from perchlorate exposure. The results of this study and an overview of additional relevant studies on the impacts of perchlorate on human health and the environment are discussed in Appendix M of this PEIS.

Perchlorate can impact thyroid function because it inhibits the transport of iodide into the thyroid. The NRC study examined short-term studies that found that to negatively impact the thyroid, iodide uptake by the body would need to be reduced by at least 75 percent for months or longer. The NRC reported results of longer term studies that found that to cause hypothyroidism in adults would require them to be given more than 0.40 milligrams per kilogram (mg/kg) of perchlorate (assuming a body weight of 70 kilograms). However, in pregnant women, infants, children, and people with low iodide intake or pre-existing thyroid dysfunction, the dose required to cause hypothyroidism may be lower.

Epidemiologic studies considered by the NRC have examined the relationship between perchlorate exposure and thyroid function and thyroid disease in newborns, children, and adults. The NRC concluded that no studies have investigated the effect of perchlorate exposure in vulnerable groups, such as low birth weight or preterm infants. In addition, these studies have not considered the impacts to the offspring of mothers who were exposed to perchlorate and had a low iodide intake. Finally, adequate studies have not been completed of maternal perchlorate exposure and neurodevelopmental outcomes in infants.

The NRC study considered the applicability of animal toxicology studies to human health and found that although studies in rats provide useful qualitative information on potential adverse effects of perchlorate exposure, they have limited applicability for quantitatively assessing human health risks associated with perchlorate exposure.

The NRC study also reviewed EPA's findings presented in the 2002 perchlorate risk assessment. A primary purpose of EPA's perchlorate risk assessment was to calculate a reference dose (RfD). The NRC study did not agree with the basis of the EPA's study, which relied on animal data. The NRC reviewed both human and animal data and found that the human data formed a better basis for risk assessments. The EPA study's draft RfD for perchlorate was 0.00003 mg/kg per day and the NRC study recommended an RfD of 0.0007 mg/kg per day. The NRC stated that this value is supported by other

clinical studies, epidemiologic studies, and studies of long-term perchlorate administration. The NRC report concluded that the proposed RfD of 0.0007 milligrams per kilogram per day should protect even the most sensitive populations. The EPA has established an official RfD of 0.0007 mg/kg/day of perchlorate consistent with this recommended RfD, which translates into a Drinking Water Equivalent Level of 24.5 ppb.

Noise

Prelaunch Activities

Prelaunch activities including evacuation and road closure activities and storing boosters, propellants, and kill vehicles would have no impact on noise.

Launch/Flight Activities

Launch activities would produce the same noise levels in all of the biomes considered in this PEIS. The potential for impact would depend on the specific launch location. Three possible issues must be addressed to determine potential noise impacts, including personnel safety, public safety, and public annoyance. The impact of noise from launches on biological resources is addressed in Biological Resources. Launches would not add new types or levels of noise to the current noise environment at existing launch sites. Noise levels produced by BMDS launches would be similar to past and current noise levels at launch sites. Launches would be relatively short noise events during which all personnel would be located in various control or blockhouses and therefore would be protected from noise by the sound attenuation provided by the building's construction. Zones in the operations area with high noise levels would be designated off-limits to non-essential personnel. Entry into these zones would be prohibited except to personnel wearing hearing protection that would reduce noise.

Sonic booms may be generated during launch or booster reentry. Each booster would propagate a unique sonic boom contour depending upon its mass, shape, velocity, and launch or reentry angle, among other variables. Areas affected by a sonic boom could extend up to several miles on each side of the focal point of the sonic boom. Sonic booms may produce overpressures as high as 8 to 16 pounds per square foot, but this would be of very short duration, lasting up to several milliseconds. (U.S. Army Space and Strategic Defense Command, 1994a) These levels of sonic booms can have minor effects on physical structures (glass failure, plaster may crack, etc.) but are not strong enough to cause injury to people.

Air Operating Environment. Noise generated by the booster launched from an air platform would reach the Earth's surface. Prior analyses of air-launched boosters showed that an Air Drop vehicle launched from an altitude of approximately 5,000 feet above MSL would generate approximately 115 dBA at ground level directly below the launch

point. (BMDO, 1998) The noise levels that reach the ground will vary depending on the altitude and attitude at which the booster is launched. This noise would decrease rapidly as the launch altitude increases; thus, launch noise would be brief.

Sea Operating Environment. Launches from sea platforms in the BOA would have fewer noise impacts because of the distance of the sea operating environment from population centers. Essential personnel would be located in an area of the sea launch environment that is protected from the noise generated during launch. Non-essential personnel would be moved to a safe distance and would be protected from the noise generated during launches. Personnel that may be exposed to loud noises would be required to wear hearing protection, such as earplugs or earmuffs, which would reduce noise levels to prescribed health and safety levels.

Postlaunch Activities

Impacts of noise from launch debris recovery activities on land are discussed below.

Launch Debris on Land. Vehicles used for booster and kill vehicle debris recovery operations (trucks and helicopters) on land would produce noise. Each recovery operation would be expected to last less than one day; thus, noise associated with debris recovery would not be a constant occurrence. Helicopter flight helmets would provide the required noise attenuation for the crew. Noise impacts from debris recovery operations would be minor.

Transportation

Prelaunch Activities

Prelaunch activities including booster fueling, road closure, and evacuations would not impact transportation. Road closures would be implemented in the areas around the launch site and along the expected trajectory. These temporary road closures would be of short duration and would be considered routine occurrences for launch sites. Prominent notices would be posted to notify the general public and local businesses of expected closures. Therefore, impacts on traffic are not expected to be significant. Existing agreements regarding road closures would be followed. These impacts would be the same in all of the biomes considered in this PEIS. Any disruption due to military convoys or roadblocks would be of short duration and would not be expected to have a significant impact on transportation.

Propellants for non-pre-fueled liquid propellant boosters would be transported from the storage facility to the fueling location in accordance with appropriate regulations and would not be expected to pose significant impacts to transportation.

Launch/Flight Activities

Issuance of NOTMARs is standard practice when a launch has the potential to impact marine areas and would allow marine vessels to clear the affected area; thus, launch activities would have no impact on marine transportation

In some biomes there are few roads and much of the transportation in the region occurs by airplane. Therefore, while launches may have little to no impact on ground transportation due to road closures, air transportation may be temporarily affected. NOTAMs would be issued prior to launch events that would notify pilots of proposed airspace closures and would permit pilots to find new routes or to delay their trip until after the airspace is reopened. Impacts to air transportation are discussed above in Airspace.

Postlaunch Activities

Impacts to transportation from debris recovery are addressed separately for land and water below.

Launch Debris on Land. Trucks and mobile ground equipment used for debris recovery operations for boosters and kill vehicles would travel both on- and off-road. Debris recovery requires a relatively small number of vehicles and therefore, is not expected to impact traffic or transportation infrastructure.

Launch Debris in Water. Debris from boosters and kill vehicles may fall into waters normally occupied by commercial shipping. The majority of international trade uses routes of least distance. The actual debris impact area for boosters and kill vehicles would be small and would depend upon the individual flight path. Prior warning of proposed launch activities through issuances of NOTMARs would enable commercial shipping to follow alternative routes away from the proposed debris impact area.

Water Resources

Prelaunch Activities

Adherence to existing policies and procedures would minimize the impacts from spills related to pre-fueled and solid propellant boosters and kill vehicles. Fueling of non-pre-fueled liquid propellant boosters would be conducted in accordance with approved procedures and all applicable regulations. All fueling would be conducted using appropriate impermeable barriers that would prevent spills from reaching bodies of water.

Launch/Flight Activities

Small amounts of hydrochloric and hydrofluoric acids would be generated from the launch of pre-fueled liquid propellant boosters. These acids could reach surface water if rainfall occurred within two hours of a launch. This is most likely to occur in the Arctic Tundra, Sub-Arctic Taiga, Deciduous Forest, and Mountain Biomes where rain is a frequent occurrence. In addition, hydrochloric acid could be produced in the Sub-Arctic Taiga, Chaparral, Grasslands, and Savanna Biomes when cool and humid conditions exist during launch activities. Given the dry conditions in the Desert Biome it is unlikely that chlorine would be converted to hydrochloric acid. The Tropical Biome is generally humid but the temperatures are not cool enough to convert the HCl produced as a result of launches to hydrochloric acid. In the BOA, the acid produced would be neutralized by calcium carbonate in ocean water. However, exhaust emissions from pre-fueled liquid propellant missiles would not significantly impact water quality.

Launch of solid propellant boosters could result in deposition of small amounts of Al_2O_3 from booster exhaust. This exhaust product could be deposited in surface waters. EPA has determined that Al_2O_3 as found in solid propellant exhaust is nontoxic. (NASA, 1990, as referenced in U.S. Army Space and Strategic Defense Command, 1994a) Al_2O_3 would be hazardous only in acidic biomes (pH less than 5) where it would dissociate into free aluminum cation. (FAA, 1996, as referenced in U.S. Army Space and Missile Defense Command, 2003)

In biomes where rain is a frequent occurrence, launches with solid boosters have an increased likelihood of contributing to acid rain, thereby increasing the amount of HCl deposited in regional surface waters. In areas with low velocity of surface and ground water movement and relatively shallow ground water table it is possible that deposition of acidic water may impact water resources. The potential for and extent of impact would need to be examined in site-specific environmental analysis.

In the absence of substantial surface and ground water bodies, launch exhaust emissions are unlikely to impact water resources. Additionally, in many desert areas, the ground water table is lower than six meters (20 feet) below ground level, which would inhibit contamination from surface pollutants. For example, the evaporation and deposition of dissolved solids in the water for thousands of years has formed a hardpan over much of the Tularosa Basin, which houses an aquifer that underlies WSMR, New Mexico, and Fort Bliss, Texas. The hardpan consists of impermeable silt and clay and aids in preventing pollution of the aquifer from the land surface. It is unlikely that the aquifer could be contaminated from surface seepage from the lower elevations of the basin. This eliminates any direct channeling to the water table. (Carmichael, 1986, as referenced in U.S. Army WSMR, 1991)

Postlaunch Activities

If residual liquid propellants were deposited in surface water (either in the ocean or in lakes or streams), nitric acid would cause a short-term pH change in the water body. The acid would mix with the water and eventually be neutralized and diluted. Hydrogen peroxide in surface water would decompose into water and oxygen within eight hours to 20 days. Kerosene or JP-8 fuel would not mix with the water, but would form a slick on the surface that would stick to surfaces it contacts. Hydrazine fuels would degrade primarily into N_2 gas and water over a period of hours to weeks, with degradation proceeding more rapidly in alkaline waters.

Impacts to water quality from a direct release on land are described in the hazardous waste section above.

Launch Debris in Water. In some instances, an early flight termination could result in propellant and debris deposition in water bodies. Some perennial surface waters could be impacted following a flight termination. However, the probability of any individual water body, spring, or creek being directly impacted is extremely low and would be a function of the amount of surface water in the impact area. An early flight termination also could possibly impact in an area of shallower ground water or an aquifer recharge zone. In any of these unlikely events, the appropriate officials would be notified.

In the event of a failure, effluents may enter water bodies if the debris impacts in surface water areas. These effluents could enter underground sources of drinking water in areas where there is a shallow ground water table. However, the release rates of materials that impact surface water would be such that no significant changes in surface water quality would be detectable.

The booster and kill vehicle would consist primarily of inert metal objects that would have little potential to contaminate water bodies. In general, a typical water contamination response would include

- Rendering the booster or debris safe,
- Stopping the flow of oxidizer or fuel,
- Neutralizing the oxidizer in the stream (or body of water) sufficiently far downstream so as to avoid a continuing hazard to water quality,
- Installing surface skimmers and absorptive materials downstream from the lead edge of contamination to collect the fuel,
- Monitoring the pH along the stream to ascertain that a background pH level has been established, and
- Removing all petroleum products from stream surfaces and returning the damaged area to an environmentally sound level.

Orbital Debris

Prelaunch Activities

No orbital debris would be produced from prelaunch activities.

Launch/Flight Activities

Orbital debris could be produced from launch/flight activities in the event of a booster failure while in the exoatmosphere. However, any debris would not be expected to remain in orbit for more than a short time, followed by deorbiting and eventual burn-up during reentry of the Earth's atmosphere.

Postlaunch Activities

A failure of a booster in the exoatmosphere may generate orbital debris. The type of orbital debris produced from a booster failure would be similar to that produced from a high altitude successful intercept. However, the amount of debris from a booster failure would be less than that produced from an intercept. The impacts of orbital debris from intercepts are discussed in Section 4.1.2.10 and were found to not pose significant impacts. Therefore orbital debris from a booster failure would similarly not pose significant impacts.

4.1.1.3 Sensors - Radars

As described in Exhibit 4-3, the analysis for radars is based upon impacts from the activation of the radar.

Air Quality

Activation emissions from radars would be limited to exhaust produced by generators. Impacts related to generator emissions are discussed in Support Assets. These impacts would be the same in all of the biomes considered in this PEIS.

Airspace

During activation of land-based radars, NOTAMs would be issued and pilots would be restricted from EMR hazard areas. NOTAMs would be sent in accordance with the conditions of the directive specified in Army Regulation 95-10, Operations to notify aircraft of EMR hazard areas during the activation of radars. Airspace restrictions would be short-term events and would not pose a significant impact on available airspace. Sufficient notice of restricted areas would be provided to allow pilots to select alternate flight paths to avoid restricted areas.

The activation of radars in the Sub-Arctic Taiga Biome may impact small civilian aircraft, which frequently transit the biome at low altitudes. Because many remote civilian airports within this biome do not have operating control towers, some aircraft pilots may be required to upgrade their communication equipment (at their own expense) to ensure that they are aware of activation activities and areas that must be avoided. Civilian aircraft would be required to contact local range control towers when transiting restricted airspace. The controllers would then be able to advise civilian pilots as to their proximity to hazard areas during activation of radars. (U.S. Army Space and Missile Defense Command, 2000) Other biomes including Arctic Tundra and the BOA are unlikely to experience impacts because small civilian aircraft would not readily occur in these regions. The Deciduous Forest, Chaparral, Grasslands, Desert, Tropical, Savanna, and Mountain Biomes are unlikely to experience impacts because these biomes are more likely to have operational control towers that could communicate with civilian aircraft.

For activation activities occurring in international airspace, procedures of the ICAO would be followed. ICAO Document 4444 is the equivalent air traffic control manual to the FAA Handbook 7110.65, Air Traffic Control. Personnel would ensure coordination with the ICAO through the FAA, to issue NOTAMs, locate ships with radar capable of monitoring the airspace, contact all commercial airlines and civil and private airports, and monitor appropriate radio frequencies to minimize potential safety impacts.

During activation of radars in the BOA, at least one Control Area Extension corridor in the BOA would remain available for use by general aviation and commercial air carriers.

Potential interference to aircraft electronic and emitter units (e.g., flight navigation systems and tracking radars) would be examined before activation of radars. A high-energy radiation area would be configured to mitigate potential impacts to aircraft and other potentially affected systems and a notice would be published on the appropriate aeronautical charts, notifying aircraft of the radio frequency radiation area. Boundaries of these radio frequency radiation areas would be configured to minimize impacts to aircraft operations and other potentially affected systems. In addition information would be published in the Airport Facility section of the FAA Airport Guide. Flight service personnel would brief pilots flying in the vicinity about the radio frequency radiation area. Radar operations would be coordinated with FAA and range officials and if possible would be programmed to limit radio frequency emissions in the direction of airways that pass within the potential interference distance.

EMR from radar activation may interact with and adversely affect aircraft operations by disabling or inadvertently initiating vital electronic equipment, including electroexplosive devices on-board aircraft. Electroexplosive devices on aircraft in flight could be illuminated by a radar main beam. Software controls and coordination with military and commercial aircraft controllers would eliminate this potential hazard. (U.S. Army Space and Missile Defense Command, 2003)

The FAA and DoD have standards, such as MIL-STD-464, for EMR interference with aircraft, which would not be exceeded. To operate in an affected area, military aircraft would have to be hardened or protected from EMR levels up to 3,500 volts per meter (peak power) and 1,270 volts per meter (average power). Commercial aircraft must be hardened or protected from EMR levels up to 3,000 volts per meter (peak power) and 300 volts per meter (average power) as mandated by the FAA by Notice 8110.71, Guidelines for the Certification of Aircraft Flying through High Intensity Radiated Field Environments. Radars would not exceed the 3,000 volts per meter power threshold.

Reducing the time on-board electronic equipment is exposed to EMR would lower the average power threshold experienced. (U.S. Army Space and Missile Defense Command, 2003) Commercial aircraft equipment would be affected only if the main beam illuminated the aircraft long enough to affect on-board electronics. Because radars are typically in constant motion, it is highly unlikely that a radar would illuminate an aircraft long enough to interfere with on-board electronics.

Activation impacts from air- and sea-based radars would be similar to those described for land-based radars. Radars located on sea-based operating environments would most likely be located far enough off the coast to not interfere with existing airfield or airport arrival and departure traffic flows. Activation of space-based radars would not be expected to impact airspace.

Biological Resources

Radar activation activities would produce the same impacts on biological resources in all of the biomes considered in this PEIS. The potential for main-beam exposure thermal effects to animals, especially birds, exists from the activation of land- and air-based radars. The *Final Ground-Based Radar Family of Radars Environmental Assessment* (1993) and *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement* (2003) analyzed potential impacts on wildlife from EMR. Additional analysis is provided in this PEIS in Appendix N. Potential effects include exposure of birds to the main radar beam, which could result in thermal heating or interference with the navigation of migratory birds, EMR impacts from the COBRA DANE radar operating on Eareckson Air Station on Shemya Island, Alaska, bird collisions with radar and radar equipment, and effects in the near shore environment.

Appendix N evaluates under what conditions a BMDS radar beam could be sufficiently powerful to cause thermal heating or to interfere with the navigational ability of migratory birds. The proposed BMDS radars would operate within five different wavebands: UHF, L, S, C, and X bands. For each of the five bands, the most powerful type of radar operating in that band was evaluated. The representative radar from each band is PAVE PAWS for UHF, COBRA DANE for L-band, Aegis for S-band, MPS-36 for C-band and SBX for X-band.

The conservative analysis presented in Appendix N indicated that there is no concern for birds flying through radar beams emanating from the X-band, C-band and UHF radars. This applies to bird flights perpendicular to or in the direction of stationary beams, as well as for beams in surveillance mode. However, for the L-band COBRA DANE radar, there may be some risk to birds flying at flight altitudes of less than 1,700 meters above the radar, when the beam is elevated between four and fifty degrees above horizontal. This is a worst-case scenario for birds migrating from Alaska along the Pacific Oceanic migration route that might fly parallel to the COBRA DANE radar beam for a portion of their flight. Birds migrating from Alaska to Asia are likely to be flying more perpendicular or at an angle to the radar beam than parallel to the beam. For higher beam elevations and for lower flying birds, migrating birds flying parallel to the beam may not receive exposures above the no-harm reference value.

In Appendix N, MDA has considered mitigation measures to reduce the possible risks to migrating birds. The mitigation measures discussed in Appendix N include

- Evaluating the possibility that the COBRA DANE radar might be tested with stationary beams during spring and fall migrations.
- Evaluating whether the locations where the COBRA DANE radar would be used are in a significant migratory route or near to a migratory stopover, such that large migratory flocks might on occasion pass through the radar beam.
- Considering use of a local Next Generation Weather Radar (NEXRAD) to help evaluate when large flocks might be in the vicinity of the radar if a risk to migratory flocks is deemed to exist, so that the timing of a test does not coincide with particularly large flocks of birds flying close to the radar.

Bird collisions with radars and radar equipment also are a concern. MDA could mitigate this risk by using highly visible paints and a change in brightness of warning lights on the antenna towers and guy wires to minimize the potential for bird collisions with radar equipment. Overall, no significant impacts to birds would be expected from the operation of radars.

Potential impacts on wildlife from the activation of sea-based radars in the near shore environment would include seabirds and shorebirds, including migratory species, striking the antennas, telescopes, and shelters or becoming disoriented due to high intensity lighting at night. To minimize the occurrence of bird strikes, antennas would be raised only as necessary and colorful streamers or other visual indicators could be used to increase visibility to birds, if there is no interference with the operation of the radar. To prevent birds from becoming disoriented, high intensity lighting would be used only when necessary and low intensity lighting would be used whenever possible. Lighting would be adequate for safe working conditions but minimized to the extent practical.

Radar main beams on sea-based operating environments would not be directed toward the ocean surface, which would limit the probability of energy absorption by surface-oriented wildlife. The power density level just below the surface of the ocean where marine mammals may be located would not exceed the PEL for uncontrolled environments. (U.S. Department of the Navy, 2002a, as referenced in U.S. Army Space and Missile Defense Command, 2003) No adverse impact would occur to whales, other marine mammals, or sea turtles found at least 1.3 centimeters (0.5 inch) below the surface. It is also highly unlikely that an individual would be on or substantially above the surface of the water for a significant amount of time within the main beam area during radar activation. Therefore, no impacts are anticipated to whales, other marine mammals, or sea turtles that might be present in the vicinity of the radar.

Previous analysis (U.S. Army Space and Missile Defense Command, 2003) has shown the potential EMR interference distance for fully-populated XBR to be only 19 kilometers (12 miles). Because space-based platforms would be placed in LEO or GEO at altitudes ranging from approximately 160 to 1,600 kilometers (100 to 1,000 miles) for LEO and approximately 35,000 kilometers (21,700 miles) or greater for GEO, it is expected that EMR would not reach Earth; thus, the activation of space-based radars would not be expected to impact biological resources.

Geology and Soils

Radar activation activities would produce the same impacts on geology and soils in all of the biomes considered in this PEIS. Impacts to geology and soils from activation of radars would be limited to accidental spills of diesel fuel from generators used to support the activation of radars. Potential impacts from releases of diesel fuel are discussed in Support Assets.

Hazardous Materials and Hazardous Waste

Radar activation activities would produce the same hazardous materials and hazardous waste impacts in all of the biomes considered in this PEIS. The types of hazardous materials used and waste generated would be similar to those currently used and generated at military installations. Antifreeze and fire suppressants would be used for radar electronic systems. Cooling equipment units would use coolant fluids, such as a mixture of ethylene glycol and water. In addition, radar components and antenna units may require periodic application of petroleum-based lubricating oils. Used petroleum, oil, and lubricants would be generated in smalls amounts are not normally considered hazardous waste (designation varies by state). (U.S. Army Space and Strategic Defense Command, 1993c) All hazardous materials used and hazardous waste generated during the activation of land- and air-based radars would be handled in accordance with applicable regulations. Accidental releases of hazardous materials would be contained in accordance with site-specific spill plans.

Temporary storage tanks and other facilities for the storage of hazardous materials would be located in protected and controlled areas designed to comply with SPCC plans. Hazardous wastes generated during radar activation activities may consist of materials such as waste oils, hydraulic fluids, cleaning fluids, cutting fluids, and waste antifreeze. The minimal quantities of hazardous waste that could potentially be generated would be disposed of in accordance with appropriate waste disposal regulations.

Impacts from hazardous materials and hazardous waste management for sea-based radars would be similar to those described for land- and air-based radars. The U.S. Navy requires that, to the maximum extent practical, ships retain hazardous waste onboard for shore disposal. If hazardous materials are discharged overboard, this must occur more than 370 kilometers (200 nautical miles) from land. Discharging hazardous materials overboard is not standard practice and would only be done in emergency situations. Twenty-five liquid discharges, such as clean ballast, deck runoff, and dirty ballast, from normal operation of military vessels are required to be controlled by installation of control technologies or use of management practices (marine pollution control devices) under the Uniform National Discharge Standard provisions of the Clean Water Act. In compliance with Uniform National Discharge Standards, the sea-based operating environment would incorporate marine pollution control devices, such as keeping decks clear of debris, cleaning spills and residues, and engaging in spill and pollution prevention practices, in design or routine operation.

Health and Safety

Radar activation activities would produce the same impacts on health and safety in all of the biomes considered in this PEIS. Safety precautions for handling, storing and transporting hazardous materials and hazardous waste releases would be followed at sites involved in BMDS activities. Each site would follow spill control and emergency response plans that would provide response actions for cleanup. Sites would maximize on-site and off-site recycling to reduce the need for waste disposal sites and handle or dispose of hazardous materials or wastes in compliance with all applicable laws, regulations, and guidance. (U.S. Army Space and Strategic Defense Command, 1993b)

Prior to activation of radars, an EMR survey would be conducted that considers hazards of EMR to personnel, to fuels, and to ordnance. The analysis would provide recommendations for sector blanking and safety systems to minimize exposures. Appropriate safety exclusion zones would be established before operation, and warning lights to inform personnel when the system is operating and emitting EMR would be installed.

Personnel exclusion areas would be established to protect personnel from potential EMR hazards during radar activation. Personnel not involved in test event activities would not be permitted to enter established hazard zones during the activation of radars. EMR

hazard zones would be established within the main beam's tracking space near emitter equipment. A visual survey of the area would be conducted to verify that all personnel are outside of the hazard zone prior to activation. Safety exclusion zones would also be established around generator wiring and cabling to protect personnel from high voltage exposure.

Potential health and safety hazards associated with the operation of radars were analyzed in previous documents. Two examples of these are *Ground-Based Radar Family of Radars Environmental Assessment* (1993) and *Environmental Assessment for Theater Missile Defense Ground-Based Radar Testing Program at Fort Devens, Massachusetts* (1994). These analyses considered operational requirements and restrictions and range-required safety procedures. It was determined that implementing safety procedures, including establishing controlled areas and limitations in the areas subject to illumination by radars, would preclude any potential safety hazard to either the public or project-related personnel from exposure to EMR.

The analysis method used to evaluate potential impacts of radio frequency radiation is the IEEE Maximum Permissible Exposure (MPE), which defines the maximum time-averaged radio frequency power density allowed for uncontrolled human exposure. The MPE method is independent of body size or tissue density being exposed. EMR hazard zones provide a safety factor 10 times greater than the MPE. MPEs are capped at 5 megawatts per square centimeter for frequencies greater than 1,500 MHz. (IEEE C95.1-1999, Standard for Safety Levels with Respect to Human Exposure to Radiofrequency EM Fields, 3 kilohertz to 300 GHz) General public exposure is typically limited to one fifth of the occupational limits.

At X-band frequencies, the IEEE standard for human exposure is 5.33 megawatts per square centimeter. For radars to have an effect on human health, the beam operating at full power would have to come in contact with a person and remain on them for 7.5 minutes (at 8,000 MHz) or 11.25 minutes (at 12,000 MHz). (U.S. Army Space and Missile Defense Command, 2003) The beam would normally be in motion, which would reduce the likelihood that a person would remain within the most intense area of the beam for any considerable length of time.

In addition to the impacts described above, activation of radars on sea-based operating environments would be coordinated with the FAA, U.S. Coast Guard, and other groups or agencies as appropriate. The implementation of software controls would prevent a radiation hazard zone from occurring on the deck of the sea-based operating environment.

Noise

Radar activation activities would produce the same noise impacts in all of the biomes considered in this PEIS. Noise impacts associated with activation of radars would be limited to noise produced by generators. Impacts related to generator noise are discussed in Support Assets.

Transportation

The activation of radars has the potential to impact air transportation. These impacts are discussed in Airspace. These impacts would be the same in all of the biomes considered in this PEIS.

NOTMARs would be issued in advanced of test events; therefore, commercial marine vessels would be able to choose transportation routes outside of proposed radar activation areas.

Water Resources

Additional personnel would be needed for the activation of radars; these personnel would increase the demand for potable water. An increase in demand could exceed the capacity of the existing infrastructure at some locations. (U.S. Army Space and Missile Defense Command, 2003) This is of particular concern in portions of the Sub-Arctic Taiga, Grasslands, Desert, Tropical, and Mountain Biomes. It is anticipated that additional packaged potable water systems would be installed to meet the demands in areas where access to potable water is limited. Site-specific studies should consider the limited potable water supplies in these areas when analyzing the impacts to water resources from the proposed activation of radars. Other biomes including Arctic Tundra, Sub-Arctic Taiga, Deciduous Forest, Chaparral, and Savanna Biomes are unlikely to experience impacts to water resources. Due to ample ground water supply, it is unlikely that a significant increase in demand would exceed the capacity of existing infrastructure in these biomes.

Impacts to water resources from activation of radars would include potential release of hazardous materials. Materials released from sea-based operating environments would be rapidly diluted and would not be found at concentrations identified as producing any adverse impacts due to the high buffering capacity of sea water in the open ocean. The ocean depth in the vicinity of sea-based radar would most likely be thousands of meters deep, and consequently, any impact from fuel or hazardous material spills would be minimal. From land- and air-based operating environments, impacts from hazardous materials releases would depend on the characteristics of the water bodies in the respective biome. No impacts to water resources would occur as a result of space-based sensors that would be in GEO.

Orbital Debris

No impacts from orbital debris would occur as a result of the activation of land-, air-, and sea-based radars.

Orbiting objects lose energy through friction with the upper atmosphere and various other orbit perturbing forces. Over time, an object may drop into progressively lower orbits and may eventually fall to Earth. As the object's orbital trajectory draws closer to Earth, it speeds up and outpaces objects in higher orbits. Once the object enters the measurable atmosphere, atmospheric drag will slow it down rapidly and cause it either to burn up or deorbit and fall to Earth.

Space-based radars could reenter the Earth's atmosphere due to failure, but would not likely result in significant impacts. Most objects break up and often vaporize under the intense aerodynamic forces and heating that occur during reentry. Most of the objects which reenter would fragment and burn in the upper atmosphere and would make only negligible changes in its chemical composition. An estimated 500 objects and thousands of debris fragments reenter the Earth's atmosphere each year; however, few survive reentry. Out of approximately 3,100 objects from 44 launches between 1956 and 1972, only 100 have survived reentry and been recovered. Even if an object does survive reentry, only one third of the Earth is land area, and only a small portion of this land area is densely populated. The chance of hitting a populated land area upon reentry would be small. (SDIO, 1992)

4.1.1.4 Sensors - Infrared and Optical Sensors

As described in Exhibit 4-3, the analysis for infrared and optical sensors is based upon impacts from the activation of the sensors.

Air Quality

Activation emissions from infrared and optical sensors would be similar to those discussed for radars. These impacts would be the same in all of the biomes considered in this PEIS.

Airspace

No impacts to airspace would be expected due to the activation infrared and optical sensors.

Biological Resources

No impacts to biological resources would be expected due to the activation infrared and optical sensors.

Geology and Soils

Impacts to geology and soils from activation of infrared and optical sensors would be similar to those discussed for radars. Infrared and optical sensor activation activities would produce the same impacts on geology and soils in all of the biomes considered in this PEIS.

Hazardous Materials and Hazardous Waste

Impacts to hazardous materials and hazardous waste from activation of infrared and optical sensors would be similar to those described for radars.

Health and Safety

Safety exclusion zones would be established around generator wiring and cabling to protect personnel from high voltage exposure. These impacts would be the same in all of the biomes considered in this PEIS.

Noise

Noise impacts associated with activation of infrared and optical sensors would be similar to those described for radars. These impacts would be the same in all of the biomes considered in this PEIS.

Transportation

There would be no impacts to transportation from the activation of infrared and optical sensors.

Water Resources

Impacts to water resources from activation activities would be similar to those described for radars. These impacts would be the same in all of the biomes considered in this PEIS.

Orbital Debris

Impacts from orbital debris related to space-based sensor activities would be similar to those described for radars. See Section 4.1.1.3.

4.1.1.5 Sensors - Laser Sensors

As described in Exhibit 4-3, the analysis for laser sensors is based upon impacts from the activation of the sensor.

Air Quality

Laser sensor activation activities would produce the same air quality impacts in all of the biomes considered in this PEIS. Laser sensors include gas lasers and solid-state lasers that expend low-level infrared radiation to form a focused laser beam. (MDA, 2003a) Potential emissions produced during activation would depend on chemicals used. These emissions would typically be released to the air where the impacts would be as discussed below.

The operation of a CO_2 gas laser sensor, like the Active Ranging System (ARS) laser associated with the ABL, would include the use of helium, N_2, and CO_2. (MDA, 2003a) None of these inert gases are considered hazardous; however, they can be asphyxiants, replacing oxygen to create oxygen-deficient conditions. A leak of these gases to the atmosphere would be insignificant relative to ambient oxygen concentrations. Impacts from asphyxiants would occur only in confined areas. Gas laser sensors could use a glycol (Refrigerant 404) closed-loop cooling system. Refrigerant 404 is an ozone-depleting substance; however, the closed-loop system would prevent releases to the atmosphere. In the unlikely event that a release does occur during testing or activation, the small amount released would quickly be dispersed and would not significantly impact air quality.

Solid-state lasers like the Beacon Illuminator Laser (BILL) and the TILL associated with the ABL have crystals as the active medium. Operation of these lasers causes thermal expansion of the crystal, which alters the effective cavity dimensions, thus changing the mode structure of the laser. The lasers are cooled by non-hazardous liquids such as water and deuterium oxide, which are in closed looped systems. No pollutant emissions are associated with the testing and activation of these lasers, therefore no impacts to air quality would be expected.

Airspace

The use of laser sensors would occur in cleared airspace within designated airspace areas. Close coordination with the FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impact on airspace use. Lasing activities would be suspended immediately when ground observers using binoculars indicate an aircraft might be approaching the area; therefore, no impacts to airspace would be expected. Laser sensor activation activities from the

ground would produce the same airspace impacts in all of the biomes considered in this PEIS.

Flight-testing and activation activities for air-based laser sensors would occur at altitudes greater than 10,671 meters (35,000 feet) above MSL. Targets would be actively engaged at or above 10,671 meters (35,000 feet) above MSL, and would not engage below the 10,671 meters (35,000 feet) horizon. This would ensure activation of the laser sensors at an upward angle from the 10,671 meters (35,000 feet) horizon, and thus above commercial aircraft traffic and away from the Earth's surface. Due to the negative impacts of cloud cover on sensing lasers and the increase in air traffic below the 10,671 meters (35,000 feet) horizon, activation of lasers in a deployed situation would be conducted above the 10,671 meters (35,000 feet) horizon as well.

Activation of lasers would occur in cleared airspace within designated airspace use. Close coordination with the FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impacts on airspace use.

Biological Resources

Impacts to biological resources as a result of activation of laser sensors could occur. Ground testing of air-based lasers has the greatest potential for impacts. Wildlife in the beam path of the laser could suffer eye damage as a result of the laser activation. Due to the short duration of the laser operations during testing and the small range area used for the ground testing, impacts to wildlife would be insignificant. Laser sensor activation activities would produce the same biological resource impacts in all of the biomes considered in this PEIS.

Flight-testing and activation of air-based laser sensors would occur at an altitude of 10,671 meters (35,000 feet) above MSL or greater. Impacts from the laser operation on biological resources on the ground would be insignificant. Birds in the beam path of the laser could suffer eye damage as a result of the laser activation. However, bird densities at 10,671 meters (35,000 feet) above MSL would be extremely low, and the time of exposure to the beam path would be extremely low as well. Also, because the laser beams from solid-state laser sensors are usually not continuous, but consist of a large number of separated or pulsed power bursts, it is highly unlikely that a bird would remain within a beam for any considerable length of time. Therefore, significant impacts to birds would not be expected. (MDA, 2003a)

Impacts from the activation of land-, and sea-based lasers would be insignificant. The beam path of land-, and sea-based lasers would be directed at an upward angle from the Earth's surface, and thus would not impact biological resources on the ground. Impacts

to birds and from beam reflection would be similar to those described for air-based laser sensors.

Impacts to biological resources as a result of testing and activation of space-based laser sensors would be insignificant. In the unlikely event that the laser was directed towards the Earth's surface, distortion from atmospheric conditions would reduce the radiance level of the lasers. The ANSI refers to the eye hazard distance as the Nominal Ocular Hazard Distance. This distance is defined as "the distance along the (propagation) axis of the unobstructed beam from a laser … to the human eye beyond which the … exposure … is not expected to exceed the appropriate MPE." (MDA, 2003a)

The Earth's surface would likely be beyond the Nominal Ocular Hazard Distance of the laser sensor, and thus, the impacts would be insignificant.

Geology and Soils

No impacts to geology and soils would occur as a result of activation of land-, sea-, air-, and space-based laser sensors. The only hazardous material that would be used to cool gas laser sensors is a gas at ambient conditions and would not impact geology and soils.

Hazardous Materials and Hazardous Waste

Laser sensor activation activities would produce the same hazardous materials and hazardous waste impacts in all of the biomes considered in this PEIS. The types of hazardous materials used and waste generated would be similar to those currently used and generated at military installations. No hazardous materials would be used during activation of lasers. Gas laser sensors would use CO_2, helium and N_2 to generate the laser, but these substances are not hazardous. These gases would be held in compressed gas tanks and would be handled according to all applicable Federal, state, and local regulations. Gas laser sensors would use a glycol (Refrigerant 404) cooling system. (MDA, 2003a) Refrigerant 404 is an ozone-depleting substance. However, the cooling system would be a closed loop system, and the refrigerant would be replaced only during routine maintenance. Used refrigerant would be handled and disposed of or recycled according to all applicable Federal, state, and local regulations. Accidental releases of hazardous materials would be contained in accordance with a site-specific spill plan.

Solid-state laser sensors would use non-hazardous crystals as the laser generating medium. These sensors could use either water or deuterium in their cooling systems. (MDA, 2003a) These non-hazardous coolants would be contained in closed-loop systems and would be recycled or replaced as needed.

Health and Safety

Laser sensor activation activities would produce the same impacts on health and safety in all of the biomes considered in this PEIS. Laser sensors are created by chemical reactions that release low levels of energy in a focused energy beam that is invisible to the naked eye. Despite its relatively low energy level, the laser beams can be hazardous to the eyes of living organisms within a certain proximity (or hazard distance) specific to the parameters of the laser beam. The MPE of the laser's energy is the standard that indicates "the level of laser radiation to which a person may be exposed without hazardous effect or adverse biological change in the eye." (ANSI Z136.1, *Safe Use of Lasers*, as referenced in MDA, 2003a) The MPE is a function of laser wavelength and exposure duration, but also varies based on waveform (pulsed or chopped), and the waveform's respective parameters (e.g., for pulsed waves, pulse width and pulse repetition frequency are additional factors in the MPE calculation).

The MPE and output parameters, such as power and divergence or beam spread, can be used to evaluate the hazard at various proximities, known as the eye hazard distances. ANSI refers to the eye hazard distance as the Nominal Ocular Hazard Distance. This distance is defined as "the distance along the (propagation) axis of the unobstructed beam from a laser … to the human eye beyond which the … exposure … is not expected to exceed the appropriate MPE."

Laser light is predominantly scattered forwards and backwards, whereas relatively little is scattered sideways. Therefore, an organism would have to look straight down the beam to be at risk. Some laser beams, such as those produced by gas laser sensors, diverge once they leave the sensor, therefore a lower hazard risk would be expected as the distance between the source sensor and a receptor increases. Other laser beams, like those produced by solid-state laser sensors, may maintain or increase their focus once they leave the sensor. When the laser's focus is maintained instead of diverging, the laser may become hazardous to an organism's eyes at a certain distance (e.g., two kilometers) before the primary focus point and stay hazardous until that same distance (e.g., two kilometers) after the primary focus point. (MDA, 2003a)

The DoD follows limitations outlined in ANSI Z136.1, *Safe Use of Lasers*, for the testing and activation of laser sensors. The limitations include establishing a restricted area excluding all but authorized and properly trained personnel, displaying warning signs designating the restricted area, removing reflective surfaces, and incorporating automatic hard-stop limits and/or laser blanking devices. This last measure would ensure that laser energy does not extend beyond natural features or backstops during testing scenarios. (MDA, 2003a) Safety exclusion zones would be established around generator wiring and cabling to protect personnel from high voltage exposure.

Noise

Noise impacts associated with activation of laser sensors would be similar to those discussed for radars. These impacts would be the same in all of the biomes considered in this PEIS.

Transportation

Testing and activation of land-, sea-, air-, and space-based lasers could impact the use of airspace. These impacts are discussed in the Airspace section. These impacts would be the same in all of the biomes considered in this PEIS.

Water Resources

Laser sensor activation activities would produce the same impacts on water resources in all of the biomes considered in this PEIS. Gases used to generate gas laser sensors are inert and would not impact water resources through atmospheric deposition. Refrigerant 404 would be used to cool gas laser sensors in a closed loop system. In the unlikely event of a spill or leak, the coolant becomes a gas under ambient conditions and would not impact water resources.

Solid-state laser sensors would use either water or deuterium oxide as a coolant. Deuterium oxide is water that contains a significantly higher proportion of deuterium atoms to ordinary hydrogen atoms. The laser coolants would operate within a closed-loop system and are only replaced during general maintenance requirements. The cooling liquids are non-hazardous and would not be expected to impact water resources.

Orbital Debris

Impacts from orbital debris related to space-based laser sensor activation activities would be similar to those described for radars. See Section 4.1.1.3.

4.1.1.6 C2BMC - Computer Terminals and Antennas

As described in Exhibit 4-3, the analysis for computer terminals and antennas is based upon impacts from the activation of the computer terminals and antennas. Impacts from site preparation and construction activities related to computer terminals and antennas are addressed in Support Assets.

Air Quality

Activation emissions from computer terminals and antennas would be limited to exhaust produced by generators. Impacts related to generator emissions are discussed in Support Assets. These impacts would be the same in all of the biomes considered in this PEIS.

Airspace

Activation activities for computer terminals and antennas would have the potential to impact airspace use by utilizing radio transmission frequencies, which may interfere with commercial air traffic control communications. The magnitude of the impact on airspace would depend on the specific location proposed. In accordance with standing regulations, MDA would coordinate radio frequency use and testing with the appropriate air traffic control agencies. A re-radiation tower is a transmission and receiving tower used in conjunction with fiber optic cable to verify the communication link between radar and an interceptor missile. Re-radiation towers can be built to heights of 31 meters (100 feet) and could impact airspace as collision hazards if constructed adjacent to airports and airfields. MDA would coordinate tower siting with the appropriate air traffic control agencies to avoid conflicts with established takeoff and landing patterns.

Biological Resources

Activation activities for land-, sea, and air-based computer terminals and antennas would have the potential to impact biological resources. The level of impact would vary based on the frequency and energy of the signal, and the proximity of the source to sensitive environments or specific threatened or endangered species, as well as the specific location proposed. In accordance with standing regulations, MDA would coordinate radio frequency use and testing with the appropriate resource management agencies.

Re-radiation towers are built to heights of up to 31 meters (100 feet). There is a potential risk of bird collisions with these towers. MDA could mitigate this risk by using highly visible paints and warning lights on the towers.

Space-based computer terminals and antennas would be in GEO and would have no impacts on biological resources.

Geology and Soils

Impacts to geology and soils from computer terminals and antennas would be limited to site preparation and construction activities. These activities are discussed in Support Assets. No impacts to geology and soils are anticipated as a result of the activation of computer terminals and antennas in any biome considered for this PEIS. (U.S. Army Space and Missile Defense Command, 2002d)

Hazardous Materials and Hazardous Waste

Regular maintenance and operation activities at land-based computer terminal and antenna sites would involve a continuous but relatively low level of hazardous materials use. These activities would produce the same hazardous materials and hazardous waste in all of the biomes considered in this PEIS. The anticipated amounts of hazardous materials used at the site are not known but are expected to be small. They could include protective coatings, lubricants and oils, motor and generator fuels, cleaning agents (isopropyl alcohol), backup power batteries, adhesives, and sealants. (U.S. Army Space and Missile Defense Command, 2002d) The use and disposal of these materials would be incorporated into hazardous material and waste management documents, such as an SWPPP and an Oil and Hazardous Substance Discharge Prevention and Contingency Plan. (U.S. Army Space and Missile Defense Command, 2002d) The hazardous materials would be stored in a centralized location for distribution when needed for maintenance. Material Safety Data Sheets would be posted at all locations where hazardous materials are stored or used. A site-specific hazardous materials management plan and an SPCC plan would be developed for the sites. (U.S. Army Space and Missile Defense Command, 2002d) The use and storage of hazardous materials would be in accordance with these regulations and applicable Federal, state, and local regulations. A Pollution Prevention Plan would be implemented for the proposed sites. This plan would control and reduce the use of hazardous materials at the installation site. (U.S. Army Space and Missile Defense Command, 2002d) In addition, the program would comply with any existing base Pollution Prevention Plan. Program personnel would continue to update the system-wide Pollution Prevention Plan, which would outline strategies to minimize the use of hazardous materials over the life cycle of the facilities.

Any hazardous waste generated from the use of these materials would be handled in accordance with appropriate Federal, state, and local regulations. Site-specific hazardous waste management plans would be in place for the operation and maintenance of the sites. If a release were to occur, all hazardous waste would be handled in accordance with appropriate regulations. In addition, a trained spill containment team would manage any release of hazardous waste at the site. (U.S. Army Space and Missile Defense Command, 2002d)

Health and Safety

Activation activities for computer terminals and antennas would have the potential to impact the health and safety of MDA personnel and the general public through the use of radio transmission frequencies and hazardous materials. These activities would produce impacts in all of the biomes considered in this PEIS; however, the impact would vary based on the site selected. The level of impact would vary based on the frequency and energy of the signal, the amount of hazardous materials to be used, and the proximity of the source to MDA personnel or the general public. MDA would train operating

personnel in the operation and maintenance of C2BMC equipment, and would not direct or use C2BMC equipment in a manner that would adversely impact the health and safety of the general public.

Noise

Computer terminal and antenna activation would produce the same type of noise in all biomes considered in this PEIS. Noise impacts associated with activation of computer terminals and antennas would be limited to noise produced by generators. Impacts related to generator noise are discussed in Support Assets.

Transportation

Impacts to transportation due to activation of computer terminals and antennas would be minimal in all biomes considered for this PEIS. Personnel operating and maintaining the components would generate the only traffic as a result of the activation. Personnel would be on site only during operational hours and during routine maintenance activities. (U.S. Army Space and Missile Defense Command, 2003) Impacts as a result of activation would be insignificant.

Water Resources

Additional personnel would be needed for the activation of computer terminals and antennas; these personnel would increase the demand for potable water. Potable water demands associated with the activation activities would be relatively minimal. However, an increase in demand could exceed the capacity of the existing infrastructure. (U.S. Army Space and Missile Defense Command, 2003) This is of particular concern in portions of the Sub-Arctic Taiga, Grasslands, Desert, Tropical, Mountain, and Savanna Biomes where access potable water may be limited. Additional packaged potable water systems could be installed to meet the demands. Site-specific studies should consider the limited potable water supplies in these areas when analyzing the impacts to water resources from the proposed activities. In other biomes including Arctic Tundra, Sub-Arctic Taiga, Deciduous Forest, and Chaparral Biomes, water resources are generally not scarce and therefore, it is unlikely that water demand from additional personnel associated with activation of computer terminals and antennas would exceed the existing capacity. However, there may be site-specific or localized water resource availability issues and these should be considered for any biome.

Operation of the components would have negligible effects on water quality. Implementation of a SWPPP and best management practices would reduce the risk of impacts from erosion and sedimentation to nearby surface waters. Compliance with the SPCC Plan would minimize the potential for accidental spills of hazardous materials and hazardous wastes to affect surface and ground water resources.

Space-based computer terminals would be in GEO and would have no impacts on water resources.

Orbital Debris

Space-based computer equipment could reenter the Earth's atmosphere due to failure, but would not likely result in significant impacts. Impacts from orbital debris related to space-based computer terminal and antenna activation activities would be similar to those described for radars. See Section 4.1.1.3.

4.1.1.7 C2BMC - Underground Cable

As described in Exhibit 4-3, the analysis for underground cable is based upon impacts from the activation of the underground cable.

Air Quality

Air quality impacts associated with underground cable would be limited to ground disturbances resulting from construction activities. These impacts are discussed in Support Assets. Activation activities related to underground cable would not have any impact on air quality in any biome considered for this PEIS.

Airspace

The activation of underground cable would not have any impact on airspace in any biome considered for this PEIS.

Biological Resources

Impacts to biological resources may occur during site preparation, these impacts are discussed in Support Assets. Activation of underground cable would not result in any impacts to biological resources in any biome considered in this PEIS.

Geology and Soils

Impacts to geology and soils would be limited to site preparation activities. Activation of underground cable would not result in any impacts to geology and soils in any biome considered in this PEIS.

Hazardous Materials and Hazardous Waste

Impacts from hazardous materials and hazardous wastes would be limited to site preparation activities. No hazardous materials or wastes would be generated from the

activation of terrestrial and marine underground cable. Therefore, no significant impacts from hazardous materials or hazardous waste would be expected in any biome considered in this PEIS.

Health and Safety

Potential health and safety hazards from site preparation include dust/particulate inhalation, improper chemical handling, and improper use of machinery; these impacts are discussed in Support Assets. No impacts to health and safety would be expected from activation-related activities in any biome considered in this PEIS.

Noise

The activation of underground cable would not produce noise that has the potential to impact sensitive receptors.

Transportation

There would be no significant impact to transportation from activation underground cable in any biome considered in this PEIS. Any necessary repairs to underground cable would require excavation of the cable. These maintenance activities could result in impacts to transportation through movement of equipment and personnel to the repair site. However, repair events would occur infrequently and would require much less activity than that needed for construction. Therefore, impacts to transportation would be insignificant.

Water Resources

Potable water demand for the installation and activation of underground cable would be small. Impacts from the demand for potable water associated with an increase in the number of project related personnel would be as described for Water Resources for Computer Terminals and Antennas. Impacts to water resources may occur during site preparation, particularly in marine environments. These impacts are discussed in Support Assets.

Orbital Debris

The use of underground cable would have no impact on orbital debris.

4.1.1.8 Support Assets - Equipment

Support equipment includes transportation and portable equipment (e.g., automotive, ships, aircraft, rail, generators, cooling units, storage tanks, chemical transfer equipment,

aerospace ground equipment), BMDS Test Bed support equipment (e.g., aircraft, vehicles, ships, mobile launch platforms, operator control units, sensor operations equipment [antenna, electronic equipment, cooling equipment, prime power units]), and weapons basing platform equipment (e.g., Heavy Expanded Mobility Tactical Truck with Load Handling System, Aegis Cruiser, ABL aircraft), as discussed in Section 2.2.4.1 and Section 4.0. This equipment is part of the military services inventory and is used to support mission-related activities.

MDA reviewed the impact analyses and conclusions in previously prepared site-specific NEPA documentation, specifically for the use of transportation of equipment and use of general portable equipment. The use of this type of support equipment has been analyzed in a number of previously prepared documents, including the *Ballistic Missile Defense Programmatic Environmental Impact Statement* (BMDO, 1994); *Ground-Based Midcourse Defense Initial Defense Operations Capability at Vandenberg Air Force Base Environmental Assessment* (MDA, 2003b); *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2003); *National Missile Defense Deployment Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2000); *Theater Missile Defense Extended Test Range Supplemental Environmental Impact Statement* (U.S. Army Space and Strategic Defense Command, 1998a); *Theater Missile Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Strategic Defense Command, 1994a): *Evolved Expendable Launch Vehicle Program Environmental Impact Statement* (U.S. Department of the Air Force, 1998); *Point Mugu Environmental Impact Statement/Overseas Environmental Impact Statement* (U.S. Department of the Navy, 2002b); and *Pacific Missile Range Facility Enhanced Capability Environmental Impact Statement* (U.S. Department of the Navy, 1998). The use of general portable equipment and transport of equipment as defined in the previously prepared NEPA documents would not result in a significant impact.

For example, analyses on generator and transportation emissions conducted at KLC showed that emissions associated with the use of the facility and associated equipment for missile defense activities would be below the 90.7-metric-ton (100-ton) per year criteria pollutant Federal *de minimis* levels that apply to a non-attainment area. However, the use of certain generators would require an amendment to the existing Pre-approved Limit Permit for KLC. (U.S. Army Space and Missile Defense Command, 2003)

In addition, at Vandenberg AFB, procedures are in place so target missile launches would not represent a significant new impact on transportation, including air traffic, vehicular traffic, rail traffic, and marine traffic. (U.S. Army Space and Strategic Defense Command, 1994) Other transportation analyses found that the use of aircraft and commercial ground transportation vehicles to ship equipment from various manufacturing locations to basing locations would result in minor air emissions that were determined to be less than significant.

In many instances, transportation activities can be categorically excluded from further NEPA analysis. In accordance with DoD regulations for implementing NEPA (32 CFR 188), CEQ regulations provide for the establishment of categorical exclusions (40 CFR 1507.3(b)) for those actions, which do not individually or cumulatively have a significant impact on the human environment. Where appropriate, DoD has established such categorical exclusions. For example, infrequent, temporary (less than 30 days) increases in air operations up to 50 percent of the typical installation aircraft operation rate, are categorically excluded.

Review of previously prepared NEPA analyses and existing categorical exclusions have indicated that impacts associated with transportation would not be significant. Transportation activities would be performed in accordance with existing operating procedures and appropriate regulations, as well as in accordance with appropriate NEPA analyses. The shipment or transportation of hazardous and non-hazardous materials would be performed in accordance with applicable DOT standards, as well as established handling and transfer procedures. Proper containment, handling procedures, separation of reactive chemicals, and worker warning and protection systems would be used where necessary. Site-specific spill prevention guidelines, including leak detection and spill control measures, would be followed. However, if the proposed BMDS would increase transportation activities or result in the use of mobile support assets over existing levels or over what has been determined to be categorically excluded, site-specific NEPA analyses might be required.

As discussed above, general portable equipment has been considered in previously prepared NEPA analyses. These analyses demonstrate that the impacts associated with their use would not be significant. The use of some specific element support equipment has also been previously analyzed, and the impacts associated with their use would not be significant.

The use and operation of support equipment would be in accordance with installation-specific requirements that consider impacts on local, regional, and global environmental resources. The ongoing activities that occur at specific installations would be performed in accordance with appropriate Federal, state, and local regulations, and therefore would not be expected to result in a significant impact. Potential operational limitations include restrictions on timing, duration, or operational requirements as dictated through consultations and memorandums of agreement with appropriate regulatory agencies.

The following sections present the impacts associated with operational changes including implementation of new operating parameters for existing support equipment. These operational changes have not been previously analyzed or categorically excluded.

Air Quality

An increase in use of support equipment that results in increased emissions of a criteria pollutant, of a HAP, or of pollutants that affect regional haze could impact air quality. The significance of such impacts on air quality depends on the local or regional regulatory setting as well as the physical climate conditions where the emissions would occur. The regulatory setting includes EPA recognized non-attainment and maintenance areas, areas that have submitted regional haze SIPs to EPA, and locations that have sensitive receptors to HAP emissions. Each of the regulated areas occurs throughout the U.S. and its territories, which include all of the biomes except for the BOA and the Atmosphere.

The physical climate conditions that would affect the intensity and severity of the impact include regions that have periods of air inversions or other climatic conditions that does not permit normal air circulation or turnover to occur. Such conditions occur in the Chaparral, Mountain, and Tropical Biomes.

For areas that fall under a regulated setting through non-attainment and maintenance area designations, regional haze requirements, and their associated SIPs, the regulatory constraints of the location would be addressed in an action specific analysis. The impacts related to the emissions of HAPs would depend on the proximity of sensitive receptors in the impacted area. This type of analysis would require dispersion modeling or other risk calculation methods to evaluate the degree of the impact and identify appropriate mitigation measures.

If emissions are produced that are greater than the *de minimis* values, or if the emission increase would equal or exceed ten percent of the total emission inventory for the entire non-attainment area, then, a Conformity Determination under the Clean Air Act would be required. The *de minimis* thresholds in non-attainment areas are presented in Section 3 in Exhibit 3-3. A review of the state specific SIPs would be performed to identify whether the actions would equal or exceed 10 percent of the total emission inventory.

Airspace

The implementation of new operating parameters for existing support equipment would not impact airspace in any of the biomes considered. An increase in operations of support assets could affect the airspace of the biome where such activities would occur. The impacts on the airspace in the various biomes would be insignificant because all operations involving support equipment would be performed in accordance with existing airspace use requirements.

Biological Resources

Operational use changes could impact biological resources in the various biomes where such activities would occur. The impacts on biological resources would result from emissions of criteria pollutants and HAPs, equipment emitting EMR or radio frequencies, operations within sensitive environments (wetlands, critical habitat, essential fish habitat, wild and scenic rivers, or other protected natural resource areas), and debris from missile intercepts, catastrophic failure, or flight terminations. Methods employed to reduce impacts on natural resources including scheduling and duration considerations, as well as informal and formal consultations with regulatory agencies would be expected to reduce the potential for impact below significant levels. Should the impacts affect a threatened or an endangered species or its habitat, essential fish habitat, jurisdictional wetlands, or another regulated resource then in addition to analysis under NEPA and other applicable laws (Clean Water Act, Endangered Species Act), regulatory agency consultation would be required. The appropriate Federal agency must be consulted under Section 7 of the Endangered Species Act when site specific analysis indicates the continued existence of a threatened or endangered species is likely to be jeopardized.

Geology and Soils

In most biomes an operational use change would not impact geology or soils. However, in the Artic Tundra and Sub-Arctic Taiga Biomes, construction or modification activities have the potential to alter the condition of the permafrost that covers the biome. In addition, these biomes may be subject to earthquakes.

When appropriate, construction would incorporate seismic design parameters consistent with the critical nature of the facility and its geologic setting. In biomes with floodplains and the coastal environments, siting of facilities should consider the proximity to 100-year floodplains and maximum probable tsunami wave run-up areas.

Hazardous Materials and Hazardous Waste

An operational use change could result in an impact from the use of hazardous materials and the generation of hazardous waste, if such materials were used in the process. Such impacts could affect the biome where the action would occur. Should an operational use change result in new hazardous materials or hazardous waste, such items would be handled in accordance with specific protocols and appropriate regulations. Federal military ranges have established procedures in accordance with Federal regulations to ensure proper handling and use of these hazardous materials. These procedures would be reviewed to ensure that they address the hazardous materials that would be used. An evaluation of the potential impacts would occur if operational changes would utilize hazardous materials or generate hazardous waste not addressed in relevant specific protocols. All hazardous waste generated would be disposed of in accordance with

applicable laws and regulations. The personnel involved in hazardous material operations would be trained in the appropriate procedures, use appropriate personal protective clothing, and be up-to-date on any specialized training in hazardous material handling, spill containment and cleanup, or other hazardous material activities

Health and Safety

An operational use change would have the potential to impact health and safety. Impacts on health and safety are not associated with particular biomes; rather they are associated with the processes and activities that would be implemented under a specific action. The personnel who would operate equipment would be familiar with standard operating procedures and would receive specific equipment training as necessary. In addition to adhering to existing procedures, all activities would be performed in accordance with the health and safety requirements of the specific installation or test range, which are designed to protect public heath and safety.

Noise

Operational changes could impact ambient noise levels. Such impacts would affect the biome where the action would occur, and include new sources of noise or new operations that would alter the intensity, frequency, or duration of a noise-emitting source. The severity of such an impact would be related to the proximity of sensitive receptors to the noise source. Receptors include DoD workers, the general pubic, noise sensitive areas (housing developments, schools), and wildlife including critical habitat. An action- or site-specific study, in accordance with NEPA, would be performed for activities that may impact noise. Such a study would identify the receptors, quantify the impact, and recommend mitigation measures.

Transportation

Operational use changes could result in impacts to transportation; however, these impacts would not be significant. Mobile equipment would be used for a limited time during a test event, or would be used to transport supplies and components to and from various facilities. As indicated in Section 4.1.1.2, the use of support equipment during launch and post-launch activities (debris recovery) would not be expected to significantly impact transportation.

Water Resources

Because operational use changes of existing infrastructure would occur at existing facilities specifically designed for the support equipment in accordance with all relevant and applicable regulations, such activities would not impact water resources in any of the biomes. Operational use changes that would result in impacts to areas not specifically

designed for use of the support equipment could be subject to additional environmental review.

Orbital Debris

No impacts from orbital debris would occur as a result of an operational use change of support equipment.

Space-based equipment (satellites) could reenter the Earth's atmosphere due to failure, but would not likely result in significant impacts. Most objects break up and often vaporize under the intense aerodynamic forces and heating that occur during reentry. Most of the objects which reenter would fragment and burn in the upper atmosphere and would make only negligible changes in its chemical composition. Even if an object does survive reentry, only one third of the Earth is land area, and only a small portion of this land area is densely populated. The chance of hitting a populated land area upon reentry would be small. (SDIO, 1992)

4.1.1.9 Support Assets - Infrastructure

The following discussion of support asset infrastructure includes BMDS Test Bed infrastructure (test ranges and associated facilities), non-BMDS Test Bed Infrastructure (radar and tracking stations), and weapons basing platform infrastructure (missile silos) as discussed in Section 2.2.4.1 and Section 4.0. This equipment is part of the military services inventory and is used to support mission-related activities.

MDA reviewed the impact analyses and conclusions in previously prepared site-specific NEPA documentation, specifically for the use and modification of existing infrastructure, repair, maintenance, and sustainment. These activities have been analyzed in a number of previously prepared documents, including the *Ballistic Missile Defense Programmatic Environmental Impact Statement* (BMDO, 1994); *Ground-Based Midcourse Defense Initial Defense Operations Capability at Vandenberg Air Force Base Environmental Assessment* (MDA, 2003b); *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2003); *National Missile Defense Deployment Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2000); *Theater Missile Defense Extended Test Range Supplemental Environmental Impact Statement* (U.S. Army Space and Strategic Defense Command, 1998a); *Theater Missile Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Strategic Defense Command, 1994a): *Evolved Expendable Launch Vehicle Program Environmental Impact Statement* (U.S. Department of the Air Force, 1998); *Point Mugu Environmental Impact Statement/Overseas Environmental Impact Statement* (U.S. Department of the Navy, 2002b); and *Pacific Missile Range Facility Enhanced Capability Environmental Impact*

Statement (U.S. Department of the Navy, 1998), and *Mobile Sensors Environmental Assessment (MDA, 2005)*.

These previous analyses show that potential impacts from infrastructure modification include construction-related impacts that could result from PM and construction equipment emissions. These emissions would be short-term, and would only affect those receptors close to construction areas. Activities that would continue in existing facilities at government and contractor installations would not result in any significant impacts. All activities would follow applicable regulations and established guidelines and management practices. Any increased water demands or demands on other utilities (electricity, natural gas, waste water disposal) that could be readily met by existing supply and treatment systems, groundwater withdrawals, or alternative sources, would not result in significant environmental impacts. (BMDO, 1994)

In many instances, use and modification or maintenance and sustainment of existing infrastructure is categorically excluded from further NEPA analysis. For example, per 32 CFR Part 651, Appendix B, construction of an addition to an existing structure or new construction on a previously undisturbed site is categorically excluded if the area to be disturbed has no more than five cumulative acres of new surface disturbance, and the construction does not individually or cumulatively have a significant effect on the human environment.

Previous analyses show that the impacts of such activities in support of the BMDS would not be significant because such activities would be performed in accordance with existing regulations. However, if proposed BMDS activities would result in major modification of existing infrastructure or major changes in use, site-specific NEPA analysis would be required. Additionally, changes in the level of human services used to support BMDS activities would be analyzed in site-specific NEPA analysis. In accordance with 40 CFR Part 1508.14, the site-specific NEPA analysis would address the socioeconomic impacts that are interrelated with impacts on the natural and physical environment.

The following sections present the impacts associated with site preparation and construction, including the modification of existing infrastructure, which are not sufficiently covered in previous NEPA analyses or categorically excluded.

Air Quality

The development of new or the major modification of existing infrastructure could impact air quality. Such impacts would affect the biome where the action would occur, and would result from site preparation and construction activities. Estimates of air quality impacts from construction are based on building square footage, acreage disturbed, and duration of construction, as well as general meteorological and soil information. Construction would require ground disturbances resulting in PM_{10} and

fugitive dust impacts. In 1995, EPA estimated that ground-disturbing activities cause the release of 1.08 metric tons (1.2 tons) of uncontrolled fugitive dust emissions per 0.4 hectare (1 acre) per month of ground-disturbing activity. (U.S. Army Space and Missile Defense Command, 2003) An estimated 50 percent of fugitive dust emissions consist of PM_{10}, though a more accurate percentage is based on the makeup of the local soil. (U.S. Army Space and Missile Defense Command, 2003) Standard fugitive dust reduction measures would be implemented when necessary. Water trucks might be used to dampen soil to minimize dust by releasing water or another biodegradable dust suppressant. The speed of construction vehicles would be restricted to limit soil separation into dust, and any soil stockpiled as fill material would be covered until use to prevent moisture evaporation and separation induced by wind. (MDA, 2003b)

The use of construction equipment would result in emissions of CO, NO_X, VOCs, and oxides of sulfur. Potential construction equipment emissions would be determined on a site-by-site basis by using emission factors from various sources including EPA. Proper tuning and preventive maintenance of construction vehicles would serve to minimize exhaust emissions and maximize vehicle performance. Construction would be conducted in accordance with all applicable laws and regulations. While the construction would cause an increase in air pollutants, it is assumed that the impact would be both temporary and localized. Once construction ceased, air quality would return to its former level.

Airspace

Site preparation and construction would not have any impact on airspace because all activities would take place on the ground and would not involve any closures or restrictions on airspace use. Modifications to infrastructure not previously addressed in NEPA analyses would not have any impact on airspace because the modifications would not result in any closures or restrictions on airspace use.

Biological Resources

Site preparation and construction could impact biological resources in the various biomes where such activities would occur. Vegetation, wildlife, and specific sensitive habitats could be affected based on the specific location of the development or modifications. The construction and expansion of buildings and roads could result in the clearing of vegetation and adverse impacts on wildlife near the activities. Site preparation activities may require pouring of pavement or spreading of gravel to facilitate mobility of the construction vehicles. Site preparation and construction activities that generate dust, irritable pollutants and noise, might temporarily disturb nearby wildlife, while permanent structures would result in the loss of habitat, displacement of wildlife, increased stress, and disruption of daily/seasonal behavior. (U.S. Army Space and Missile Defense Command, 2002d) Construction of infrastructure could lead to increased surface runoff. The combination of increased noise levels and human activity would likely displace some

small mammals and birds that forage, feed, nest, or have dens within a 15-meter (50-foot) radius of such activities. (U.S. Army Space and Missile Defense Command, 2002d) Whenever possible, construction and site preparation activities would occur on or near previously disturbed areas.

In Artic Tundra, Chaparral, and Tropical Biomes site preparation and installation activities for underground cable could impact species that rely on the shore environment including species of pinnipeds, shorebirds, waterbirds, otters and whales, and sea turtles. The installation of marine underground cable through near shore areas and through shoreline and tidal areas could disturb the habitats that these species depend on.

Pinnipeds and shorebirds are easily startled by noise and movement. (U.S. Army Space and Missile Defense Command, 2003) Site preparation and construction activities could cause a range of behavioral responses from heightened alertness to abandonment of favorable habitat areas. (U.S. Army Space and Missile Defense Command, 2003) It may also be possible for site preparation and construction noise to lead to nest abandonment or changes in migration routes. The severity of the response would depend on the intensity (noise level, area of the disturbance) of the installation project, the proximity to the pinniped and shorebird habitats, and the sensitivity of the species. Site-specific analyses would more accurately assess the potential impacts of the proposed activities on biological resources.

Shorebirds are very sensitive to noise during the nesting season. (U.S. Army Space and Strategic Defense Command, 1998a) The flushing of shorebirds from nests could result in the exposure of eggs to excess cold/heat and to predation.

Construction activities would be planned and sited to avoid regulated habitats (jurisdictional wetlands, critical habitat, or essential fish habitat). Should the impacts affect a threatened or an endangered species or its habitat, essential fish habitat, jurisdictional wetlands, or another regulated resource then in addition to analysis under NEPA, compliance with other laws (e.g., Clean Water Act, Endangered Species Act, Marine Mammal Protection Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act), and regulatory agency consultation would be required. The appropriate Federal agency must be consulted under Section 7 of the Endangered Species Act when site specific analysis indicates the continued existence of a threatened or endangered species is likely to be jeopardized.

Environmentally sensitive habitats could be impacted by site preparation and construction activities for underground cable. Trenching through coral reef areas would adversely impact the reef. Coral reefs are slow developing habitats that are very sensitive to changes in water quality. The trenching activity would disturb seafloor sediment and would temporarily increase the turbidity of the water column. This would lower the solar light penetration that the reefs depend on for growth and energy. (University of the

Virgin Islands, 2003) In addition, the trenching activities would break up existing reef. Studies have shown that coral reefs are very sensitive to physical disturbances. Reefs that have been physically damaged can be more susceptible to disease. (University of the Virgin Islands, 2003) Underground cable site preparation and construction activities would comply with EO 13089 and would be avoided to the extent possible in coral reef areas.

The marine underground cable installation activities could startle and temporarily displace whales and sea otters. However, these species would likely return once the installation is complete. Installation activities that occur in freshwater and tidal streams could cause siltation and disturbance of maturation and feeding habitats for some species of fish. (U.S. Army Space and Strategic Defense Command, 1994a) Site-specific studies should analyze the potential impacts of the proposed activities on the biological resources of the affected environment.

Studies have shown that artificial light can affect sea turtle behavior. (U.S. Army Space and Strategic Defense Command, 1998a) Artificial light associated with construction sites could confuse nesting sea turtles causing abandonment of nesting sites. Artificial lights could also confuse hatchling turtles by causing them to move in circles and reducing their chances of making it safely to the ocean. (U.S. Army Space and Strategic Defense Command, 1998a) Trenching and backfilling in sea turtle nesting areas could disturb buried nests or cover the nests with a sand layer too deep for the hatchlings to escape. Because sea turtle and shorebird nesting is a seasonal process, construction activities could be coordinated to avoid nesting seasons. Site-specific analyses would more accurately assess the potential impacts of the proposed activities on biological resources.

Geology and Soils

Typical construction activities that could adversely affect local geology and soils include cut-and-fill operations, paving operations, compaction, mixing, grading, and general soil erosion. Exposed soils become dry and porous and shift easily resulting in increased erosion rates. Paving operations would degrade the quality of the soil as it mixes with tar and reduces permeable surfaces. Best Management Practices[53] would be implemented to minimize negative short-term effects of clearing and grading activities during site preparation, as well as excavations and grading for connecting infrastructure, roadways and parking. Any construction activities greater than five-acres would be required to obtain an NPDES storm water run-off permit, which typically specifies the Best Management Practices for the entire construction site. Except for localized soil compaction in the construction area, long-term impacts to the soils resulting from

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[53] A best management practice is a business function, process, or system considered superior to all other known methods, that improves performance and efficiency in a specific area. (Office of the Secretary of Defense Comptroller iCenter, 2004)

construction would not be anticipated. (U.S. Army Space and Missile Defense Command, 2003)

Site preparation and construction could impact the geology and soils of the Artic Tundra and Sub-Arctic Taiga Biomes. Such impacts would be related to activities that alter the condition of the permafrost that covers the biome.

Whenever possible, construction and site preparation activities would occur on or near previously disturbed areas to limit or reduce disturbance of undisturbed areas. Construction would incorporate seismic design parameters consistent with the critical nature of the facility and its geologic setting. In biomes with floodplains and the coastal biomes, facilities should be constructed outside of existing 100-year floodplains and beyond established limits for tsunami wave run-up for a maximum probable tsunami event. (U.S. Army Space and Missile Defense Command, 2003)

Hazardous Materials and Hazardous Waste

Site preparation and construction and development could result in an impact from the use of hazardous materials and the generation of hazardous waste. Such impacts would affect the biome where the action would occur. Based on the type of infrastructure the potential hazardous wastes that would be generated during construction and site preparation include solvents, cutting fluids, acetylene, and various paint products, used acetone, motor fuels, heating fuels, waste oils, hydraulic fluids, used batteries, and waste antifreeze. Small quantities of solvents are typically used for degreasing or other cleaning activities. Residual solvents would be disposed of as hazardous waste along with contaminated materials (e.g., rags). Hazardous waste disposal would take place at permitted sites equipped to handle the safe and proper disposal of such materials.

A Pollution Prevention Plan would be implemented for new or major modification to existing infrastructure. This plan would control and reduce the use of hazardous materials at the site. (U.S. Army Space and Missile Defense Command, 2002d) In addition, the program would comply with any existing base Pollution Prevention Plan. Program personnel would continue to update the system-wide Pollution Prevention Plan, which would outline strategies to minimize the use of hazardous materials over the life cycle of the facilities.

Renovation and site preparation activities may generate wastes that include asbestos-containing material and lead-based paints. Prior to any existing building modification or demolition, surveys would be conducted to determine if these materials are present in the modification area. A licensed asbestos abatement contractor, in accordance with state and Federal regulations, would perform renovations in these instances. All removed asbestos would be disposed of in a solid-waste landfill designed to receive asbestos-containing material. Management and abatement of asbestos and lead-based paint at

selected sites would be compliant with management plans such as a Lead-Based Paint Management Plan, an Asbestos Management Plan, an Asbestos Operating Plan, as well as the applicable legal requirements. (U.S. Army Space and Missile Defense Command, 2003)

Health and Safety

Site preparation and construction could impact health and safety. Impacts on health and safety are not associated with particular biomes, rather are associated with the processes and activities that would be implemented under a specific action. Potential health and safety hazards from site preparation and construction activities include dust/particulate inhalation, improper chemical handling, and improper use of machinery. General safety procedures would be followed to protect construction workers, base personnel, and the general public during site preparation and construction activities. No impacts to human health and safety from site preparation and construction activities would be expected, if all applicable legal requirements are met.

Construction activities would produce physical hazards such as noise, electrical, heavy-moving equipment and machinery, welding, and earth moving and digging activities. Health and safety procedures would be compliant with appropriate management plans and applicable regulations. Any waste would be collected and segregated as non-hazardous, hazardous, and possibly special wastes for proper disposal in accordance with applicable legal requirements.

The design of new facilities or the modification of exiting facilities would incorporate measures to minimize the potential for and impact of health and safety related accidents. Operating procedures and training would be instituted to minimize the potential for and impact of releases of hazardous materials. Specific health and safety plans would be developed including evacuation plans, and notification of local and offsite emergency response as required.

Noise

Site preparation and construction and development of new or the major modification of existing infrastructure could impact ambient noise levels. Such impacts would affect the biome where the action would occur, and would be related to construction activities or new operations that would alter the intensity, frequency, or duration of a noise emitting source, and would depend upon the sensitivity of the receptor to the sound generated. Receptors include workers, wildlife, and the public in the proximity of the noise source. Site preparation and construction activities would be comparable to common construction activities. The amount of noise generated would depend upon the amount and type of construction being done. Construction on existing facilities would likely be minor; construction of new infrastructure could result in larger impacts. Personnel that may be

exposed to loud noises would be required to wear hearing protection, such as earplugs and earmuffs, which would reduce the noise levels to prescribed health and safety levels. An action or site-specific study would be performed for activities that may increase noise levels. Such a study would identify sensitive receptors and their locations, quantify the impact, and recommend mitigation measures.

Transportation

Site preparation and construction activities may require the use of heavy machinery the transportation of which could cause changes in the amount of congestion on the existing road network. In addition, an influx of construction workers may change the level of demand for access to the existing roadways. In general, these activities would not be expected to cause a significant impact on transportation. However, if these changes in demand and congestion demonstrate the potential for significant impact, site specific analyses would be prepared.

Water Resources

Site preparation and construction could impact water resources by increasing operations resulting in a discharge of wastewater. Modifications or construction activities would follow site-specific protocols for storm water and ground water pollution prevention, and would require application for appropriate permits and development of pollution prevention plans for protection of water resources on- and off-site. For new installations, site-specific documentation would be required to determine potential effects of construction and operation activities on surface water, ground water, and floodplains. The impacts on water resources would be analyzed in accordance with NEPA and other appropriate regulations, including the Clean Water Act and any applicable international or foreign legal requirements for activities outside of the U.S.

Orbital Debris

No impacts from orbital debris would occur as a result of site preparation and construction.

4.1.1.10 Support Assets - Test Assets

The following discussion of support asset test assets include assets of the BMDS Test Bed (test sensors and communications) and assets that are used to support the BMDS Test Bed (targets, countermeasures, and simulants) as discussed in Section 2.2.4.1 and Section 4.0. This equipment is part of the military services inventory and is used to support mission-related activities.

MDA reviewed the impact analyses and conclusions in previously prepared site-specific NEPA documentation, specifically for the development and use of test assets. These activities have been analyzed in a number of previously prepared documents, including the *Ballistic Missile Defense Programmatic Environmental Impact Statement* (BMDO, 1994); *Ground-Based Midcourse Defense Initial Defense Operations Capability at Vandenberg Air Force Base Environmental Assessment* (MDA, 2003b); *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2003); *National Missile Defense Deployment Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2000); *Theater Missile Defense Extended Test Range Supplemental Environmental Impact Statement* (U.S. Army Space and Strategic Defense Command, 1998a); *Theater Missile Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Strategic Defense Command, 1994a): *Evolved Expendable Launch Vehicle Program Environmental Impact Statement* (U.S. Department of the Air Force, 1998); *Point Mugu Environmental Impact Statement/Overseas Environmental Impact Statement* (U.S. Department of the Navy, 2002b); and *Pacific Missile Range Facility Enhanced Capability Environmental Impact Statement* (U.S. Department of the Navy, 1998).

MDA also reviewed existing categorical exclusions to determine which activities associated with the development and use of test assets are categorically excluded from further NEPA analysis.

The activities previously analyzed and those that are categorically excluded include the development, manufacturing, and assembly of components and component prototypes at existing DoD and non-DoD (contractor) facilities.

For example, the *Theater High Altitude Area Defense Initial Development Program Environmental Assessment* (U.S. Army Space and Strategic Defense Command, 1994c) found that all manufacturing and engineering activities would be accomplished in existing facilities and would use personnel routinely engaged in these types of activities. The facilities and personnel utilized would operate at levels and intensities similar to current conditions, which would result in no significant impacts. In addition, the EA found that manufacturing and engineering various missile components would involve the use of various hazardous materials. Because the facilities would comply with the CCR, Title 22, Division 4, Environmental Health; Title 40 CFR, Parts 260-280, and the RCRA, as well as specific facility guidelines that describe procedures for items such as correct storage, labeling, and transportation of hazardous waste, such activities would be not significant.

Similarly, because the manufacturing and assembly of the BMDS components would occur at existing facilities, would follow established standard operating procedures to protect worker and public safety, and would be performed in accordance with all appropriate and relevant laws and regulations, the impacts associated with manufacturing

would not be significant. However, should an activity require new or major modification to an existing DoD-owned or operated manufacturing facility, or require the preparation of new assembly standard operating procedures, action-specific NEPA analysis would be conducted.

The use of test assets in various configurations has been considered in previous NEPA analyses. Most of this equipment is sensor, tracking (optical, laser, and radar systems), and communications systems. The use of such equipment is both installation- and scenario-specific. Previous analyses have shown that impacts associated with the use of support equipment for test assets would not be significant.

The use of targets and their boosters, target test objects, simulants and countermeasures at some specific locations has been considered in previous NEPA analyses. For example, the *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement* (U.S. Army Space and Missile Defense Command, 2003), shows that the Peacekeeper target missile would contain less solid rocket fuel and would produce lower exhaust emissions that existing target missiles. In addition, modeling of target missiles to include dual launches demonstrated that the level of HCl emitted would be below the 1-hour Air Force standard, but would exceed the peak HCl standard for a short duration. The emission levels for both CO and Al_2O_3 were determined to be within NAAQS and California AAQS; therefore, the nominal launch of a single Peacekeeper target missile is anticipated to remain within NAAQS, California AAQS, and Air Force Standards. Previous analyses show that the impacts associated with the use of targets and their boosters for activities associated with the proposed BMDS would have no significant impacts.

The use of drones as targets has been considered in previous NEPA analyses and has not been found to result in significant impacts. Drones are used to mimic the heat and radar returns of missiles and aircraft, and can use various countermeasures to deceive interceptors. The potential for impacts from the use of drones is influenced by the specific flight pattern to be flown and intercept altitude, if appropriate. Site specific analysis including debris analysis might be required for future proposed actions using drones.

The development and use of individual test assets (e.g., sensors, targets, and drones) have been analyzed in site-specific NEPA documents, which found no significant impacts from such activities. The development and use of those test assets as defined in the previous site-specific NEPA documents would not result in a significant impact. The combined impact associated with test assets and the other BMDS components was analyzed in Section 4.1.2, Test Integration. The following sections present the impacts associated with the use of simulants and countermeasures.

Air Quality

The development and use of simulants, countermeasures, and drones could impact air quality in the biome where the action would occur. The prelaunch activities where the simulants, countermeasures, and drones are assembled and prepared for use would result in the emissions of Federal or state-listed criteria pollutants, as well as potential HAP emissions. The HAPs that may be released would depend on the chemical composition of the simulant or countermeasure, or the materials associated with the drones. The use of simulants, countermeasures, and drones during test events would result in emissions to the air; however, based on the parameters of the specific test, the emissions may be at an elevation above 914 meters (3,000 feet) and would not affect ground level air quality. Based on the chemical composition and volume of the simulant, or the composition and volume of volatile substances in the countermeasure component or drone, the emissions above 914 meters (3,000 feet) may impact air quality in terms of ozone depletion (particularly in the upper troposphere and stratosphere), acid rain, and global warming. Existing impact analyses prepared in accordance with NEPA and standard operating procedures would be reviewed to ensure that the activities would not result in a significant impact. Site-specific environmental analysis would be completed to evaluate potentially significant impacts.

Airspace

The use of delivery systems (boosters) for the simulants and countermeasures, as well as the simulants and countermeasures themselves could impact airspace of the biome where the action would occur. The operating altitudes, lateral orientation, specific type of airspace, and the region of influence are the parameters of specific test scenarios that influence the degree of the impact on airspace. The use of simulants and countermeasures may increase the duration and severity of impact on a particular airspace. The impacts of specific simulants and countermeasures on airspace would be reviewed in accordance with NEPA.

Biological Resources

The development and use of simulants and countermeasures could impact biological resources of the biome where the action would occur. Should the impacts affect a threatened or endangered species or its habitat, essential fish habitat, or jurisdictional wetlands, or another regulated resource then in addition to analysis under NEPA, compliance with other applicable laws (e.g., Clean Water Act, Endangered Species Act, Marine Mammal Protection Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act), as well as regulatory agency consultation could be required.

Geology and Soils

The development and use of simulants and countermeasures would not impact geology; however, such activities could impact soils in the biome where the action would occur. The impact would result from the deposition of the simulants or countermeasures on the soil. The severity of the impact would be based on the composition of the simulant or countermeasure. The impacts related to the use of new simulants or countermeasures would be evaluated as necessary in accordance with NEPA.

Hazardous Materials and Hazardous Waste

The development and use of simulants and countermeasures could result in an impact from the use of hazardous materials and the generation of hazardous waste. A wide variety of hazardous materials may be used in the development of simulants and countermeasures including solvents, and toxic metals and substances. No radioactive materials would be used in the development and use of simulants and countermeasures. The development and use of specific simulants and countermeasures would include a life cycle analysis of potential impacts, including specific decommissioning activities for any hazardous materials. Hazardous materials or hazardous waste associated with the use of a simulant or countermeasure would be handled in accordance with installation and range specific protocols and appropriate regulations. Federal military ranges have established procedures in accordance with Federal regulations to ensure proper handling and use of these hazardous materials. These procedures would be reviewed to ensure that they address the appropriate hazardous materials. An evaluation of the potential impacts in accordance with NEPA and other relevant regulations would occur if the use of a simulant or countermeasure would utilize hazardous materials or generate hazardous waste not addressed in installation specific protocols. All hazardous waste generated would be disposed of in accordance with appropriate state and Federal regulations. The personnel involved in hazardous material operations would be trained in the appropriate procedures and would use appropriate personal protective clothing and would be up-to-date on any specialized training in hazardous material handling, spill containment and cleanup, or other hazardous material activities.

Health and Safety

The development and use of simulants and countermeasures could impact health and safety. Impacts on health and safety are not associated with particular biomes; rather they are associated with the processes and activities that would be implemented under a specific action. Health and safety impacts would be commensurate with the chemical composition of the simulant and the operating parameters involved with the use of simulants and countermeasures. New standard operating procedures that address safe handling and operational requirements to protect public health and safety would be developed for new or modified simulants and countermeasures. Such plans would

address health and safety issues for general operation and handling, as well as health and safety operations for system and operational testing and failures. The personnel who would operate and handle such equipment would be familiar with the standard operating procedures and would receive specific training as necessary. These actions would be performed in accordance with health and safety requirements of the specific installation or test range, which are specifically designed to protect public heath and safety.

Noise

The development and use of simulants or countermeasures would not impact noise within any biomes because these activities do not generate noise. The noise associated with the delivery system (i.e., booster) of a simulant or countermeasure is presented in Weapons – Interceptors.

Transportation

The development and the use of simulants would not impact transportation. As indicated in Section 4.1.1.2, short-term road closures along launch trajectories, the issuance of NOTAMs and NOTMARs to notify pilots and mariners of area closures, and debris recovery activities would not be expected to impact transportation.

Water Resources

The development and use of simulants and countermeasures could impact water resources in the biome where the action would occur. The severity of the impacts would depend on the chemical composition of the simulant or countermeasure. Impacts would occur from the deposition of simulants and countermeasures on surface waters, or from simulants migrating through soils to ground water. The disposal of simulants or countermeasures would follow appropriate protocols for the composition of the simulants and countermeasures. Prior to using simulants or countermeasures that may impact water resources, the impacts related to the specific chemical composition and operational testing environment would be analyzed in accordance with NEPA. Compliance with Federal and state regulations also would be required.

Orbital Debris

If countermeasures are used and remain on-orbit, they have the potential to disrupt or damage other space-based assets (e.g., communication satellites). However, orbiting objects lose energy through friction with the upper atmosphere and various other orbit perturbing forces. Over time, objects including countermeasures, may drop into progressively lower orbits and may eventually fall to Earth. As the object's orbital trajectory draws closer to Earth, it speeds up and outpaces objects in higher orbits. Once

the object enters the measurable atmosphere, atmospheric drag will slow it down rapidly and cause it either to burn up or deorbit and fall to Earth.

4.1.2 Test Integration

Test integration considers the range of integrated testing activities the BMDS proposes to implement to transition from the testing of individual components to the evaluation of how they will work together and perform as the BMDS. Modeling, simulation, and analysis; MDIE; and integrated missile defense wargames are virtual tests (modeling and computational analyses) or software compatibility and communication tests that would be conducted within existing laboratory or test facilities. Because of the nature of these tests, no significant impacts would occur in any biome. However, activities associated with GTs and SIFTs would have the potential for environmental impacts.

GTs test components for interoperability. Such tests would assess and evaluate the C2BMC integration of the various components as well as the assimilation and use of the various sensors tracking system data. No laser weapons would be activated and no interceptors would be launched during GTs. To conduct these tests, multiple sensors and C2BMC components could be used from land-, air-, sea-, and space-based operating environments that would coordinate the control and transfer of information between weapons based on land, sea, and in the air. These sensors and C2BMC components could be activated from within the same biome or across several biomes.

For purposes of this analysis, two representative scenarios that could be used for SIFTs were considered. These two scenarios involve similar activities (launches of targets, use of multiple sensors, and use of land-, sea-, and air-based weapons); however, they differ in number of target launches and number of weapons used. Both scenarios may be used to support the proposed BMDS and are analyzed in this PEIS.

SIFT Scenario 1 – Single Weapon with Intercept represents the simplest SIFT and would include the launch of a single target and use of a single weapon component to intercept the target. This scenario would use multiple sensors and C2BMC components as described for GTs. Under SIFT Scenario 1, the launch of the target and the activation of a laser or launch of an interceptor may occur within the same biome (e.g., all within the Desert Biome) or may involve multiple biomes (e.g., target launch from the Tropical Biome and laser activation or interceptor launch in the BOA). As BMDS capabilities are proven, a second SIFT Scenario is envisioned that would build upon SIFT Scenario 1.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts would include the launch of up to two targets. For each target launch, more than one weapon component (land-, sea-, or air-based) would be able to engage or "take a shot" at the target. Dual-target or interceptor launches would occur within seconds or minutes of each other. As with SIFT Scenario 1, numerous sensor components also would acquire the target and relay tracking

data. Under this test scenario, the two targets may be launched from one biome and the weapons may be activated or launched from the same or different biomes.

Environmental Consequences

Component testing would continue to occur under Alternative 1. These component tests would be conducted in addition to the proposed System Integration Tests. SIFTs would generally be designed around planned component flight tests. However, MDA may schedule additional tests that are not part of previously planned flight tests. Therefore, the total number of target and interceptor launches and laser, sensor, and C2BMC activation events would increase when compared to the No Action Alternative. This would increase the total number of tests, and thus the magnitude of environmental impacts.

The environmental consequences associated with the use of BMDS components under Alternative 1 are analyzed in Section 4.1. Impacts from activities that are discussed earlier in this PEIS will not be discussed in this section. Therefore, the analysis of System Integration Tests will focus on those environmental impacts that are unique to these types of tests. For this programmatic analysis, a qualitative impact assessment was completed for each resource area because specific System Integration Test parameters have not been developed that would provide quantitative values.

The activities associated with each type of System Integration Test analyzed in this PEIS include

- **Integrated GTs**. The activation of multiple sensors and C2BMC components, and passive activation of weapons (e.g., powering the tracking and communication aspects of the weapons system but not firing the weapon) within the same biome or across several biomes, which would coordinate the control and transfer of information between land-, sea-, and air-based weapons.

- **SIFT Scenario 1 – Single Weapon with Intercept**. The activation of multiple sensors and C2BMC components within the same biome or across several biomes coupled with the launch of one target and the activation of a laser or launch of an interceptor, and the debris from an intercept. Because the impacts associated with the use of multiple sensors and C2BMC components is discussed for GTs, this portion of the impacts analysis will not be repeated for this scenario.

- **SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts**. The activation of multiple sensors and C2BMC components within the same biome or across several biomes coupled with the launch of up to two targets from the same biome or different biomes, the activation or launch of multiple weapons in the same biome or multiple biomes, and the debris from each intercept. Because the impacts associated with the

use of multiple sensors and C2BMC components are discussed for GTs, this portion of the impacts analysis will not be repeated for this scenario.

4.1.2.1 Air Quality

Integrated GTs

The emissions from generators required to power sensor and C2BMC systems could impact air quality. However, these generators would only be operated for a short time and the emissions associated with the activation of one generator would be a small fraction of *de minimis* thresholds. Activating multiple generators in a single biome or across multiple biomes would not have a significant impact on air quality.

The activation of radars, infrared, and optical sensors would not impact air quality. Leaks of inert gases, such as helium, N_2, and CO_2, from gas propellant laser sensors could occur; however, a leak of these gases to the atmosphere would be insignificant relative to ambient oxygen concentrations. There are no air emissions associated with the activation of solid-state lasers; therefore, no impacts to air quality would be expected. An increase in the number of laser sensors activated during GTs would not have a significant impact on air quality regardless of whether the sensors were located in the same or multiple biomes.

SIFT Scenario 1 – Single Weapon with Intercept

In addition to the impacts presented under GTs, the emissions from SIFT Scenario 1 would include emissions from activation of lasers and launches. The primary exhaust products of boosters and lasers would be as described for weapons components. An intercept would result in the release of gases and PM.

For a target launch and the activation of a laser or launch of an interceptor occurring in the same biome, the emissions from laser activation and launches combined with the release of gases and particulates from an intercept could impact air quality. Exhibit 4-11 shows the combined emission products from the launch of a representative target and interceptor within the same biome. Exhibit 4-12 shows the emission products from the launch of a representative target and the activation of a laser within the same biome. Emissions from launch activities and laser activation would not be expected to result in significant impacts to air quality. EPA uses six criteria pollutants as indicators of air quality, including ozone, CO, NO_2, SO_2, PM, and lead, and has established a maximum concentration for each, above which adverse effects on human health may occur. Of these pollutants, only CO is emitted during the launch of targets and the launch or firing of weapons. The *de minimis* level for CO is 91 metric tons (100 tons) per year. As shown in Exhibits 4-11 and 4-12, CO levels for the launch of a target and a launch of an interceptor would be only three percent of the *de minimis* level. The CO levels for the

launch of a target and the activation of a laser also would be less than two percent of the *de minimis* level. The magnitude of potential impacts from other emissions from launch and laser activation would depend on the biome in which the activities took place and would be analyzed in site-specific analyses. Impacts to air quality from laser activation and launches occurring in different biomes would not have the additive impacts of activities occurring within the same biome.

Exhibit 4-11. Emission Products from Launches of Representative Targets and Interceptors in metric tons (tons)

Emission Product	Target	Interceptor	Total
Al_2O_3	2.30 (2.54)	3.01 (3.32)	5.31 (5.85)
CO	1.75 (1.93)	0.98 (1.08)	2.73 (3.01)
HCl	1.73 (1.91)	1.77 (1.95)	3.50 (3.86)
N_2	0.68 (0.75)	5.77 (6.36)	6.45 (7.11)
H_2O	0.92 (1.02)	1.93 (2.13)	2.85 (3.15)
H_2	0.16 (0.17)	0.00 (0.00)	0.16 (0.17)
CO_2	0.34 (0.37)	1.47 (1.62)	1.81 (1.99)
Other	0.00 (0.00)	0.16 (0.18)	0.16 (0.18)

Source: Dailey, 1993 as referenced in U.S. Army Space and Strategic Defense Command, 1994d and U.S. Army Space and Missile Defense Command, 2003.

Exhibit 4-12. Emission Products from Launches of Representative Targets and Lasers in kilograms (pounds)

Emission Product	Target	Laser	Total	Total metric tons (tons)
Al_2O_3	2,300 (5,060)	-	2,300 (5,060)	2.30 (2.54)
CO	1,747 (3,846)	-	1,747 (3,846)	1.75 (1.93)
HCl	1,733 (3,815)	-	1,733 (3,815)	1.73 (1.91)
N_2	680 (1,497)	108 (238)	788 (1735)	0.79 (0.87)
H_2O	924 (2,033)	540 (1,190)	1464 (3223)	1.46 (1.61)
H_2	156 (344)	23 (51)	179 (395)	0.18 (0.20)
CO_2	336 (739)	396 (873)	732 (1612)	0.73 (0.81)
Oxygen	-	270 (595)	270 (595)	0.27 (0.30)
Cl	-	36 (79)	36 (79)	0.04 (0.04)
Ammonia	-	81 (179)	81 (179)	0.08 (0.09)
Iodine	-	13 (29)	13 (29)	0.01 (0.01)

Source: U.S. Army Space and Strategic Defense Command, 1993c; Dailey, 1993 as referenced in U.S. Army Space and Strategic Defense Command, 1994d and U.S. Department of the Air Force, 1997b

SIFT Scenario 2- Multiple Weapons with Multiple Intercepts

In addition to the impacts presented under SIFT Scenario 1, the emissions from launching any two targets (liquid- or solid-propellant) from the same location at the same time would not be expected to result in significant impacts to air quality, provided that such an activity is within the operating parameters of the launch facility or range. The launch or activation of multiple weapons and use of additional support equipment would result in a localized increase in emissions. The concentration of the localized emissions and the subsequent severity of the impact would vary based on the number of launches or activations and support equipment, the proximity (both geographically and in time) of each launch or activation and operation of support equipment, and the specific location of such activities within a biome. The combined impacts of all the emissions associated with SIFT Scenario 2 (emissions from support equipment, launches, laser activations, and debris from intercepts) might result in significant impacts to air quality. Site-specific environmental analysis would be completed to evaluate potentially significant impacts.

4.1.2.2 Airspace

Integrated GTs

EMR and other radio frequency transmissions associated with radar sensors and C2BMC equipment activated during GTs could potentially impact airspace operations by interfering with communication and navigation equipment. Coordination with the appropriate FAA ARTCC, relevant military installations, and relevant foreign countries with jurisdiction over affected airspace would minimize the potential for impact from these tests.

In addition, laser sensors have the potential to cause eye damage to aircraft pilots. All laser sensors would be operated according to appropriate range safety regulations. An increase in the number of laser sensors activated during GTs would not be expected to significantly impact airspace.

SIFT Scenario 1 - Single Weapon with Intercept

In addition to the impacts presented under GTs, the impacts associated with airspace from SIFT Scenario 1 would include the additional restricted airspace associated with launches and the activation of lasers. Launches of targets and the activation or launch of a weapon, and impact of the target and interceptor would occur in designated areas of cleared airspace. Close coordination with the appropriate FAA ARTCC, relevant military installations, and foreign countries with jurisdiction for airspace management would minimize the potential for any adverse impacts on airspace use and scheduling. In addition, before conducting an operation that is potentially hazardous to non-participating aircraft, NOTAMs would be issued.

Retrieval of debris on land would occur within the boundaries of the designated impact area; therefore, debris retrieval would have no impact on navigable airspace or airborne activities outside the restricted airspace complex. It is not anticipated that debris falling into the BOA would be retrieved.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

In addition to the impacts presented under SIFT Scenario 1, the additional impacts to airspace under SIFT Scenario 2 would result from a larger portion of cleared airspace required to support the specific SIFT, the increased duration of the test, the additional debris areas associated with two targets and multiple intercept attempts, and increased operation of support equipment, which could result in an increase in the disruption of commercial and civilian air travel and operations. Close coordination with the appropriate FAA ARTCC, military installations, and relevant foreign countries with jurisdiction over affected airspace would reduce the potential impacts to airspace. Upon completion of such coordination for each test, there would be no significant impacts to airspace.

4.1.2.3 Biological Resources

Integrated GTs

Impacts to biological resources resulting from GTs would include EMR emissions from radar sensors and laser beams from laser sensors. The size, motion, and orientation of the beams would limit the beam exposure time on biological resources. An increase in the number of radar sensors operating within a biome would increase the risks to biological resources, but the impacts would be insignificant.

SIFT Scenario 1 – Single Weapon with Intercept

In addition to the impacts presented under GTs, the impacts from SIFT Scenario 1 would include the emissions associated with activation of lasers, including CO_2, ammonia, and chlorine. Such impacts are considered to be minor as the laser would be operated for a few seconds per launch, and would not emit large quantities of gases. Potential impacts from launches include emissions, deposition of hazardous materials, debris associated with intercepts, and noise associated with launch and flight. Impacts to biological resources associated with SIFT Scenario 1 activities would result primarily from the noise associated with launch and intercept. Sonic booms may create startle responses in some animals. Debris from the intercept could directly hit an animal. Coordination and consultation with appropriate regulatory agencies, as well as adherence to appropriate and relevant international treaties, would be required to address any potentially significant impacts on biological resources. Impacts to biological resources would depend on the

biome in which the launch and intercept took place. The potential for and extent of impact would need to be examined in site-specific environmental analysis.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

In addition to the impacts presented under SIFT Scenario 1, the environmental impacts to biological resources under SIFT Scenario 2 are related to the biome and the threatened and endangered species, the unique or sensitive environments, and the migratory, breeding, and feeding activities that occur in the biome, which would be affected by such activities. Site-specific environmental analysis would be completed to evaluate potentially significant impacts.

4.1.2.4 Geology and Soils

Integrated GTs

Impacts to geology and soils as a result of GTs would be limited to fuel spills associated with generators. Appropriate control, handling, and clean up procedures would be in place for any hazardous material spills or leaks. An increase in the number of sensors or C2BMC systems tested within a biome would not significantly increase the impacts to geology and soils.

SIFT Scenario 1- Single Weapon with Intercept

In addition to the impacts presented under GTs, the impacts from SIFT Scenario 1 would include increased soil acidity from the emission of small amounts of chlorine if the laser is activated in a humid biome. Similarly, HCl emitted primarily from launch of solid propellant boosters could be deposited on the soil in the form of acid rain and result in increased soil acidity.

Impacts to geology and soils also may result from the emissions and subsequent deposition of PM and any simulant used in the target. A target launch and the activation or launch of a weapon would not result in a significant impact to geology and soils.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

The activities performed under SIFT Scenario 2 would not impact geology. In addition to the impacts presented under SIFT Scenario 1, the environmental impacts to soils under SIFT Scenario 2 would be related to the biome, the characteristics and condition of the soil, and the type and amount of material that would be deposited on the soil during a test event. Site-specific environmental analysis would be completed to evaluate potentially significant impacts.

4.1.2.5 Hazardous Materials and Hazardous Waste

Integrated GTs

GTs would involve an increase in the volume of hazardous materials and hazardous wastes used and generated by the testing of sensors and C2BMC systems. However, hazardous materials and hazardous waste would be handled in accordance with all applicable regulations, and each test location would have an SPCC plan in place to handle any spills or leaks of hazardous materials. An increase in the use of sensors and communication systems in a biome would not result in significant impacts from hazardous materials and hazardous waste.

SIFT Scenario 1 – Single Weapon with Intercept

SIFT Scenario 1 would potentially increase the impacts from hazardous materials and hazardous waste. The impacts from laser activation would include the production of spent laser chemicals, which would be neutralized and treated as waste. Potential impacts from launches include fueling procedures (if applicable) and debris disposal. Appropriate waste management and disposal procedures would be in place to safely manage these substances in accordance with applicable regulations.

For a target launch and the activation of a laser or launch of an interceptor, impacts from hazardous materials and hazardous waste would not result in a significant impact. Applicable regulations and procedures would be followed and would prevent impacts from management and disposal of hazardous materials or hazardous waste. If appropriate, debris from launches would be handled in accordance with approved disposal requirements.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

The activities under SIFT Scenario 2 would use more hazardous materials and would generate more hazardous waste than those under SIFT Scenario 1. The increased use and generation of hazardous materials and hazardous waste would not result in a significant impact. Hazardous materials and hazardous waste including debris (if appropriate) would be handled in accordance with approved disposal requirements.

4.1.2.6 Health and Safety

Integrated GTs

Operation of multiple sensors and C2BMC systems during GTs would increase potential risks to health and safety. All health and safety procedures would be followed in the operation of the sensors and C2BMC systems. Appropriate safety exclusion zones,

personnel exclusion zones, and EMR hazard zones would be established prior to testing. All participating personnel would be trained and certified in the risks associated with testing and operation of sensors and C2BMC systems. As a result, the increase in risks to health and safety would not be considered significant.

SIFT Scenario 1 – Single Weapon with Intercept

The potential impacts associated with SIFT Scenario 1 would increase the exposure to health and safety risks from those found in the GTs. Impacts would include potential impacts from laser operation including handling laser chemicals and potential contact with the laser beam. Potential impacts to health and safety from launches include exposure to explosives, contact with launch debris, and exposure to noise produced during launch.

Impacts to health and safety from activities associated with SIFT Scenario 1 would depend on the biome in which launches and intercept took place. Because launches would take place on facilities or at locations with restricted access, members of the public would not be exposed to these hazards. Operating procedures would be developed to protect personnel, reducing any potential impacts to less than significant levels. Individuals exposed to health and safety risks would be DoD or DoD contractor personnel, other participants in the test, and other support, security, or observer personnel. All personnel exposed to elevated health and safety risks would be trained and certified for such risks, while the remaining test personnel would be briefed on the health and safety risks in accordance with appropriate and relevant regulations and standard operating procedures. The establishment of restricted impact areas and adherence to applicable regulations and standard operating procedures would reduce impacts from debris to less than significant levels.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

The activities associated with SIFT Scenario 2 would result in an increased exposure to health and safety risks in comparison to those associated with SIFT Scenario 1. The increased exposure to health and safety risks associated with SIFT Scenario 2 would not be expected to result in a significant impact.

4.1.2.7 Noise

Integrated GTs

Impacts from noise as a result of GTs would be limited to noise associated with the operation of generators required to activate sensors and C2BMC. Noise impacts from generators would be dependent on the intensity, the duration, and the proximity of the noise to sensitive receptors. The generators would be operated during tests, and sea- and

air-based systems typically would not be operated in proximity to sensitive receptors. Site-specific environmental analysis would be completed to evaluate potentially significant impacts. However, in general, the increase in noise from multiple generator use within a biome would not be significant.

SIFT Scenario 1 – Single Weapon with Intercept

Potential impacts from noise associated with SIFT Scenario 1 would be greater than those associated with GTs. For a target launch and the activation of a laser or launch of an interceptor, up to two sonic booms would be generated. The sonic booms could each produce overpressures as high as 8 to 16 pounds per square foot; however, these would be of short duration, lasting up to several milliseconds. Noise produced above 12,192 meters (40,000 feet) would not affect ground level noise. In addition, launches would occur at locations where members of the public would not be exposed to launch noise in excess of OSHA regulations. Personnel associated with launch would either be removed from the launch location or would use hearing protection to reduce exposure to less than significant levels. Impacts would be dependent on the biome in which launches and intercept took place. However, in general, noise associated with SIFT Scenario 1 would not be significant.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

The activities under SIFT Scenario 2 would result in increased noise levels when compared to SIFT Scenario 1. Activities under SIFT Scenario 2 will be evaluated for noise on a case-by-case basis.

4.1.2.8 Transportation

Integrated GTs

Impacts to transportation as a result of GTs would be limited to those associated with radar sensors. Air and marine transportation could be impacted by EMR emissions. Impacts to air transportation are described in Airspace. For marine transportation, NOTMARs would be issued in advance of the testing event to allow vessels to plan alternate routes to avoid the EMR hazard areas. The activation of multiple sensors in a biome would not significantly impact transportation.

SIFT Scenario 1 – Single Weapon with Intercept

In addition to the impacts presented under GTs, potential impacts to transportation from SIFT Scenario 1 would include temporary road closures around launch sites, expected flight trajectories, and debris impact zones. Debris recovery on land would require a relatively small number of vehicles. For SIFT Scenario 1 activities, areas around the

launch sites, the expected flight trajectories, and debris impact zone would be affected. However, closures of roads, airspace, and marine areas would be of short duration and would be considered routine occurrences for launch sites. Issuance of NOTAMs and NOTMARs would allow vehicles to clear the affected areas. All transportation of the components and support assets would be completed in accordance with the appropriate and relevant national and international standards and requirements. Therefore, no significant transportation impacts would be expected.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

The increase in transportation requirements or any increases in the frequency, duration, or number of transport route closures that would be required under SIFT Scenario 2 would not result in a significant transportation impact. All closures would be coordinated through the appropriate authorities.

4.1.2.9 Water Resources

Integrated GTs

GTs would involve an increase in risk for hazardous materials and hazardous waste spills and an increase in demand for potable water. Spills and leaks of hazardous materials and hazardous waste would be handled according to appropriate regulations and to the spill plans at each test site. Potable water supplies could be impacted, especially in areas with limited water supplies and infrastructure. The increase in personnel in these areas associated with GTs could exceed the capacity of the available potable water supply infrastructure. Site-specific environmental analysis would be completed to evaluate potentially significant impacts. However, in general impacts to water resources would not be significant.

SIFT Scenario 1 – Single Weapon with Intercept

Impacts to water resources from SIFT Scenario 1 would add to those associated with GTs. Impacts would include the generation of HCl from laser activation and launches of some boosters. For a target launch and the activation of a laser or launch of an interceptor occurring in the same biome, impacts to water resources would be dependent on the biome in which the launches and intercept took place. An early flight termination could result in propellant and debris from the target and interceptor being deposited in water bodies. Specific impacts on water resources are related to the biome and the unique or sensitive environments (wetlands, marine sanctuaries, essential fish habitat) that occur in the biome, which would be affected by such activities. Coordination and consultation with appropriate regulatory agencies would be required to address any potentially significant impacts on water resources. Impacts to water resources from laser

activation and launches occurring in different biomes would not have additive impacts of activities occurring within the same biome.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

In addition to the impacts presented under SIFT Scenario 1, the environmental impacts on water resources under SIFT Scenario 2 would result from increased pollutant emissions and subsequent deposition associated with the launches and successful intercepts or flight terminations. Site-specific environmental analysis would be completed to evaluate potentially significant impacts.

4.1.2.10 Orbital Debris

Integrated GTs

The amount of orbital debris would not be impacted by GTs.

SIFT Scenario 1 – Single Weapon with Intercept

The amount of orbital debris could increase under SIFT Scenario 1, from GMD or boost phase intercepts in the upper atmosphere. Such increases in orbital debris would be temporary, as studies indicate that objects in orbit between 200 and 399 kilometers (123 to 248 miles) reenter the atmosphere within a few months. (Interagency Group [Space], 1989, as referenced in U.S. Department of the Air Force, 1998)

Orbiting objects lose energy through friction with the upper reaches of the atmosphere and various other forces. Over time, the object falls into progressively lower orbits and eventually falls to Earth. As the object's orbital trajectory draws closer to Earth, it speeds up and outpaces objects in higher orbits. Once the object enters the measurable atmosphere, atmospheric drag will slow it down rapidly and cause it either to burn up or deorbit and fall to Earth.

NASA has determined that a significant amount of debris does not survive the severe heating that occurs during reentry. (NASA, 2003a) Components that do survive are most likely to fall into the oceans or other bodies of water or onto sparsely populated regions. During the past 40 years an average of one cataloged piece of debris fell back to Earth each day. No serious injury or significant property damage caused by reentering debris has been confirmed. Although it cannot be determined with certainty how much debris would be produced under SIFT Scenario 1, the fact that the orbital debris would only be on orbit for a limited time, the majority of the orbital debris would burn up upon reentry into the Earth's atmosphere, other orbital debris that falls to Earth daily has not caused injury or significant property damage indicates that orbital debris associated with SIFT Scenario 1 would not pose significant impacts.

SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts

Increases in orbital debris would be greater under SIFT Scenario 2 than SIFT Scenario 1. Under SIFT Scenario 2 additional space-based sensors and C2BMC assets would be used and therefore these platforms could also produce orbital debris. As with SIFT Scenario 1, it may also be possible for debris from boost or midcourse intercepts to become orbital debris until it reenters the Earth's atmosphere. As defined under SIFT Scenario 1, the orbital debris would not pose a significant impact.

4.1.3 Activities at Locations Outside of the Continental U.S.

Some MDA activities may occur outside the continental U.S. (OCONUS), its territories and possessions. Because NEPA and other environmental laws do not generally apply to OCONUS activities, various EOs and DoD directives and instructions have been implemented. Appendix G describes the framework within which the MDA activities must comply regarding these international activities.

Impacts Analysis for MDA OCONUS Activities and Facilities

To conduct an analysis of potential impacts from proposed OCONUS BMDS activities, MDA considered global biomes based on similar ecological characteristics rather than political boundaries. The activities conducted in international locations would have the same emissions and stressors on resource areas as those conducted within the U.S. and its territories, e.g., types and amounts of emissions and noise from booster launches. However, the receiving environment may be very different and international regulatory requirements may have different standards for what constitutes a trigger for significance of impacts. The framework in terms of overseas environmental planning and compliance issues is addressed in Appendix G.

4.1.4 Cumulative Impacts

The proposed action addressed in this PEIS is the development, testing, deployment, and planning for decommissioning for an integrated BMDS to protect the U.S., its allies, and its interests worldwide. Thus this action is worldwide in scope and potential application, and only activities similar in scope have been considered for cumulative impacts. Regional or local past, present, or future activities would be considered for cumulative impact assessment as appropriate, during subsequent site- or action-specific NEPA analyses. Worldwide launch programs for commercial and government programs were determined to be activities of international scope that might reasonably be considered for cumulative impacts in this PEIS. Launches can contribute to cumulative impacts in three specific areas – ozone depletion, global warming, and orbital debris.

The number of BMDS projected launches was estimated at 515[54] during the years 2004 to 2014. Worldwide projected launches, which include 77 U.S. commercial launches (FAA AST, 2003); 99 U.S. government launches (NASA, 2003a; NASA, 2003b; NASA, 2003c); 183 foreign commercial launches (COMSTAC, 2003); and 476 foreign government launches (NASA, 2004; Gunter's Space Page, 2004; Spaceflight Now, 2004a; Spaceflight Now, 2004b), were estimated to total 835 launches during the years 2004 and 2014.

Exhibit 4-13 summarizes both BMDS and other worldwide launch emission loads to the stratosphere, based on the projected number of launches identified above. Note that the load to the troposphere would be the same as the load to the stratosphere because the residence time is assumed to be the same and the propellant types used are assumed to be the same (see Appendix I for assumptions used to estimate launch emissions loads).

Exhibit 4-13. Summary of Estimated Emission Loads to the Stratosphere from Launches (2004-2014) in metric tons (tons)*

	HCl	Al_2O_3	CO_2	H_2O	N_2	Cl	NO_X	CO
BMDS Projected Launches	1,344 (1,481)	2,432 (2,680)	3,118 (3,436)	1,810 (1,994)	0 (0)	18 (20)	1,821 (2,006)	0 (0)
Worldwide Projected Launches	6,526 (7,192)	11,777 (12,979)	57,287 (63,130)	50,298 (55,429)	0 (0)	87 (96)	94,933 (104,616)	0 (0)
Total Projected Launches	7,870 (8,673)	14,210 (15,659)	60,404 (66,566)	52,108 (57,413)	0 (0)	105 (116)	96,754 (106,623)	0 (0)

*Calculations subject to rounding; see Appendix I for additional information on launch emission load calculations and related assumptions

Global Warming

Potential launch emissions that could affect global warming include CO and CO_2. Unlike CO_2, CO is not a greenhouse gas; however, it can contribute indirectly to the greenhouse gas effect and is therefore included in this analysis. The cumulative impact on global warming from launches would be insignificant compared to other industrial sources (e.g., energy generation using fossil fuel) and activities (e.g., deforestation and land clearing). Estimated BMDS launch emissions load of CO and CO_2 to the troposphere and stratosphere would account for only five percent of the emissions load from launches worldwide. However, even when accounting for both BMDS launches and other launches worldwide, the CO and CO_2 load would be extremely small compared to

[54] Projected number of launches based on MDA estimates.

emissions loads from other industrial sources just in the U.S. As Exhibit 4-14 indicates, the amount of CO and CO_2 emissions load from all launches over the ten-year period under consideration would account for 3.5 x 10^{-4} percent of CO and CO_2 emissions load from U.S. industrial sources in one year.

Exhibit 4-14. Comparison of Emission Loads of CO and CO_2 to both the Troposphere and Stratosphere

Emission Sources	CO and CO_2 Emissions in metric tons (tons)*
BMDS Projected Launches from 2004-2014	6,235 (6,871)
Worldwide Projected Launches from 2004-2014	114,573 (126,260)
Other Industrial Sources in the U.S.**	34 billion (37.6 billion) for one year 136.3 billion (150.2 billion) for four years

* Calculations subject to rounding
** Source: EPA, 2003d

Ozone Depletion

Ozone depletion is a major concern, as the stratospheric ozone layer protects the Earth from adverse levels of ultraviolet radiation. Chlorine is a chemical of primary concern with respect to ozone depletion. Launches are one of the human-made sources of chlorine in the stratosphere. The cumulative impact on stratospheric ozone depletion from launches would be far below and indistinguishable from the effects caused by other natural and man-made causes. Projected BMDS launches would include boosters considerably smaller than those used on the Space Shuttle; therefore, the air quality impacts from the Space Shuttle provide a conservative upper bound for comparison.

As Exhibit 4-15 indicates, the emission loads of chlorine (as HCl and free Cl) from both BMDS and other launches worldwide as projected from 2004-2014 would account for only 0.5 percent of the industrial Cl load from the U.S. over the 10-year period. The majority of the chlorine load from launches is as HCl, which does not readily break down into the ozone-depleting substance Cl. Also, the HCl in the troposphere is usually quickly removed by water in the atmosphere. The emissions load of chlorine from launch activities would also be minimal in comparison to the 362,874 metric tons (400,000 tons) of inorganic chlorine created annually by photolysis of historical reservoirs of CFCs. (DOT, 2001b)

Exhibit 4-15. Comparison of Emission Loads of Chlorine (HCl and Free Cl) in both the Troposphere and Stratosphere

Emission Source	Cl Emissions in metric tons (tons)*
Projected BMDS Launches 2004-2014	2,724 (3,002)
Projected Worldwide Launches 2004-2014	13,226 (14,580)
Other Industrial Sources in the U.S 2004-2014**	2,993,694 (3,000,000)

* Calculations subject to rounding
**Source: Adapted from DOT, 2001b

Almost all of the studies to date on ozone depletion from launches are based upon homogenous gas phase chemistry, which does not address the effects from particulates and aerosols released during ascent. There are no commonly accepted models that accurately predict the effects from particulates and aerosols on ozone depletion caused by launches. Future analysis of launches using heterogeneous chemistry could significantly alter the understanding of cumulative impacts of launch emissions on stratospheric ozone depletion. There is some evidence that particulates may play a larger role in ozone-depletion reactions than has currently been demonstrated. If this were the case, assuming only homogeneous gas phase chemistry (i.e., no effects from particulates or aerosols), the amount of ozone depletion actually occurring as a result of emissions from launches would be underestimated.

Orbital Debris

Orbital debris would be produced by space-based BMDS sensors and space-based C2BMC components and could be produced by midcourse and boost phase intercepts with sufficient energy. The effects of orbital debris on other spacecraft would depend on the altitude, orbit, velocity, angle of impact, and mass of the debris. Debris less than 0.01 centimeter (0.004 inch) in diameter can cause surface pitting and erosion. Over a long period of time, the cumulative effect of individual particles colliding with a satellite might become significant because the number of particles in this size range is very large in LEO. Long-term exposure of payloads to such particles is likely to cause erosion of exterior surfaces and chemical contamination, and may degrade operations of vulnerable components such as optical windows and solar panels. Debris between 0.01 and 1 centimeter (0.004 and 0.4 inch) in diameter could cause significant impact damage that could be serious, depending on system vulnerability and defensive design provisions. Objects larger than 1 centimeter (0.4 inch) in diameter can produce catastrophic damage. Although it is currently practical to shield against debris particles up to one centimeter (0.4 inch) in diameter (a mass of one gram [0.05 ounce]), for larger debris, current shielding concepts become impractical. (Office of Science and Technology Policy, 1995, as referenced in U.S. Department of the Air Force, 1998)

Astronauts or cosmonauts engaging in extra-vehicular activities could be vulnerable to the impact of small debris. On average, debris one millimeter (0. 04 inch) in diameter is capable of perforating current U.S. space suits. (Cour-Palais, 1991, as referenced in Commission on Engineering and Technical Systems, 1995)

Solid rocket motors eject Al_2O_3 dust (typically less than 0.01 centimeter [0.004 inch] in diameter) into the orbital environment, and may release larger chunks of unburned solid propellant or slag. However, solid rocket motor particles typically either decay very rapidly, probably within a few perigee passages, or are dispersed by solar radiation pressure. Thus, the operational threat of solid rocket motor dust is probably limited to brief periods of time related to specific mission events. (Office of Science and Technology Policy, 1995, as referenced in U.S. Department of the Air Force, 1998)

Orbital debris generated by launch vehicles contributes to the larger problem of pollution in space that includes radio-frequency interference and interference with scientific observations in all parts of the spectrum. For example, emissions at radio frequencies often interfere with radio astronomy observations. (Office of Technology Assessment, 1990, as referenced in U.S. Department of the Air Force, 1998) Not only can orbital debris interfere with the performance of scientific experiments, but also it can even accidentally destroy them. (Scheraga, 1986, as referenced in U.S. Department of the Air Force, 1998)

Orbiting objects lose energy through friction with the upper reaches of the atmosphere and various other forces. Over time, the object falls into progressively lower orbits and eventually falls to Earth. As the object's orbital trajectory draws closer to Earth, it speeds up and outpaces objects in higher orbits. Once the object enters the measurable atmosphere, atmospheric drag will slow it down rapidly and cause it either to burn up or deorbit and fall to Earth.

NASA has determined that a significant amount of debris does not survive the severe heating that occurs during reentry. (NASA Orbital Debris Program, 2003) Components that do survive are most likely to fall into the oceans or other bodies of water or onto sparsely populated regions like the Canadian Tundra, the Australian Outback, or Siberia in the Russian Federation. During the past 40 years an average of one cataloged piece of debris fell back to Earth each day. No serious injury or significant property damage caused by reentering debris has been confirmed. Although it cannot be determined with certainty how much debris would be produced from BMDS activities, or how much debris is produced by worldwide launches annually, the fact that orbital debris reenters on a daily basis and this debris has not caused injury or significant property damage indicates that orbital debris produced by BMDS space-based sensors would not pose significant impacts. Therefore the cumulative impacts of orbital debris for Alternative 1 are expected to be less than significant.

4.2 Alternative 2 – Implement BMDS Using Land-, Sea-, Air-, and Space-Based Weapons Platforms

Alternative 2 includes the use of weapons from land-, sea-, air-, and space-based platforms. The impacts associated with the use of weapons from land, sea, and air platforms would be the same as discussed for Alternative 1. Therefore, the analysis for this alternative will focus only on the additional impacts of using weapons from space-based platforms. Although MDA has historically conducted research and development efforts on space-based lasers, these efforts have been put on hold as kinetic energy missile technology, which is more promising in the short term, is being pursued. Therefore, this PEIS only addresses space-based interceptor technology and any future application of lasers from a space platform would be addressed as required.

4.2.1 Impacts Analysis

If Alternative 2 were selected, additional environmental analysis could be needed as the technologies intended to be used become more defined and robust. Because the impacts associated with the use of interceptors from space-based platforms are not environment specific, the impacts analysis for this alternative will not discuss specific environments.

The life cycle activities for space-based interceptors would be as described in Section 4.1 and in Exhibit 4-3.

For purposes of impacts analysis for space-based interceptors it was assumed that all manufacturing activities impacts would be the same as those discussed for Alternative 1. Therefore, they are not discussed for Alternative 2.

Space-based interceptors would be launched on launch vehicles and maintained from platforms similar to other satellites used for DoD and commercial purposes in a prescribed orbit around the Earth. The launch vehicles used to insert the weapon platforms into the proper orbit would likely be existing launch vehicles; and therefore, the impacts of the launch would be as described for Support Assets.

The impacts associated with the use of space-based interceptors and debris and deorbiting are unique to space and are discussed in some detail in this section. The NEPA and EO 12114, which require review of the environmental impact of certain Federal actions, do not apply to impacts in space. However, this PEIS considers the impacts that space-based objects, including orbital debris, might have on the terrestrial environment. Therefore, this analysis will focus on the impact to Earth of the launch of interceptors and the reentry of orbital debris.

Interceptors

Interceptors may be used from space-based platforms. Although preliminary design and development has been considered for a space-based interceptor, in the future MDA may develop and test other space-based interceptor designs.

Space-based interceptors would most likely be placed in LEO via existing launch vehicles. The booster used on the space-based interceptor would be either a pre-fueled liquid propellant booster or a solid propellant booster, with properties similar to those interceptors described in Alternative 1. It is unlikely that a non-pre-fueled liquid propellant would be used on a space platform. The interceptor and platform would likely be composed of aluminum, magnesium, carbon resin composites, titanium, and limited quantities of beryllium.

Space-based interceptors would be capable of providing defense against threat missiles in all flight phases. Because of this, the launch scenario may direct the interceptor towards Earth along a trajectory to intercept a threat missile. In planning test activities, the MDA would select launch scenarios that would result in both the interceptor and the debris impacting in designated areas either in the ocean or on cleared land-based ranges. The space-based interceptors may also be equipped with an FTS that, in the event of a launch mishap, would be activated to destroy the interceptor. The resulting debris from the interceptor would be the same as that produced during a successful intercept and would be as discussed for other debris.

Orbital Debris

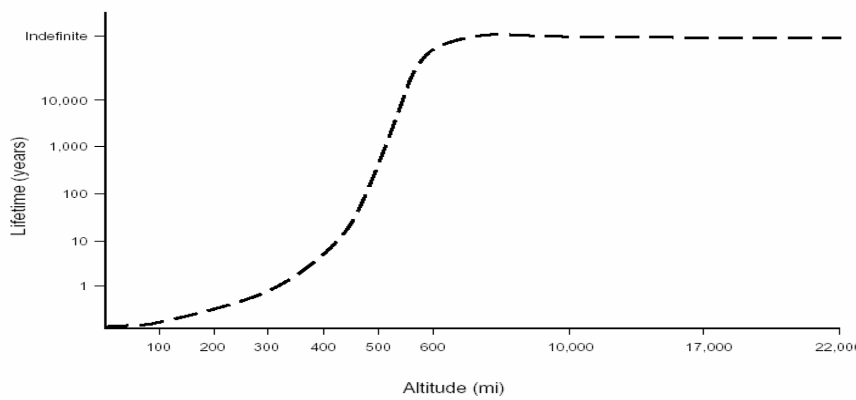
Orbital debris presents the most significant deviation from the impacts described for Alternative 1. Orbital debris generally refers to material that is on orbit as the result of space initiatives, but is no longer serving any function. Orbital debris can return to Earth via controlled or planned deorbiting or via uncontrolled deorbiting. Using interceptors from a space-based platform would create orbital debris, from successfully intercepting a threat missile and causing it to break up or from the break up of an unsuccessful interceptor or the space platform.

Space-based weapons platforms would contribute to orbital debris while in orbit and upon deorbiting, potentially hitting other satellites in their paths. The U.S. Air Force Space Command, located inside Cheyenne Mountain AFS, Colorado, tracks objects larger than 10 centimeters (4 inches) in diameter orbiting Earth. Space surveillance conducted by U.S. Space Command includes reentry assessment to predict when and where an object would reenter the Earth's atmosphere. U.S. Space Command does not, however, make surface impact predictions. NASA estimates that there are over 9,000 objects larger than 10 centimeters (4 inches) in diameter in space. The estimated population of particles between 1 and 10 centimeters (0.4 and 4 inches) in diameter is

greater than 100,000, and the number of smaller particles probably exceeds tens of millions. (NASA, 2001, as referenced in U.S. Department of the Air Force, 1998)

The addition of orbital materials from the operation of space-based weapons would contribute to the accumulation of orbital debris in LEO. Unless reboosted, satellites in orbits at altitudes of 200 to 399 kilometers (124 to 248 miles) reenter the atmosphere within a few months. At orbital altitudes of 399 to 900 kilometers (248 to 559 miles), orbital lifetimes can exceed a year or more depending on the mass and area of the satellite. Above 900-kilometer (559-mile) altitudes, orbital lifetimes can be 500 years or more. (Interagency Group [Space], 1989, as referenced in U.S. Department of the Air Force, 1998) Exhibit 4-16 shows the relationship between altitude and orbital lifetime.

Exhibit 4-16. Relationship between Altitude and Orbital Lifetime



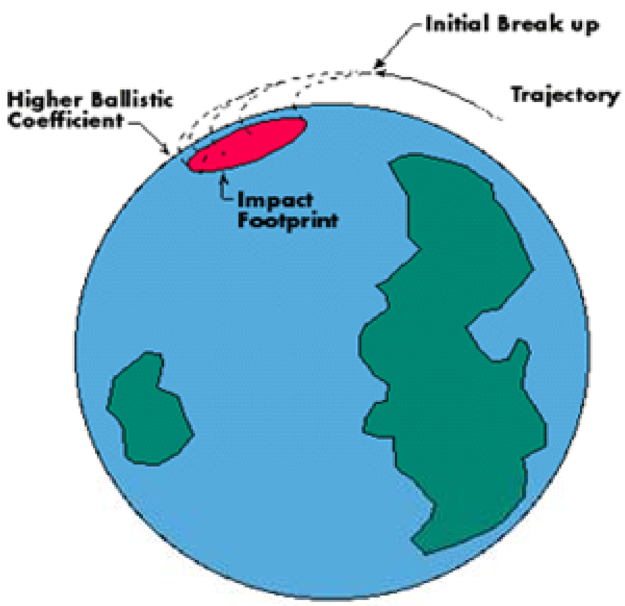
Debris in orbit gradually loses altitude. When orbiting objects enter dense regions of the atmosphere, friction between the object and atmosphere generates heat. This heat can melt or vaporize all or portions of the object resulting in minimal amounts of debris reaching the surface of the Earth. During reentry, the deceleration of the debris creates loads on the structure that can exceed ten times the acceleration of gravity. These loads combine with the high temperature to cause the debris to break apart.

Some debris can survive reentry heating. This occurs if the debris component’s melting temperature is high, or if its shape enables it to lose heat fast enough to keep the temperature below the melting point. (Aerospace Corporation, Center for Orbital Reentry and Debris Studies, 2003) In general, components made of aluminum and other materials with low melting temperatures do not survive reentry, while components made of materials with high melting temperatures, such as stainless steel, titanium, and glass, often do survive. Large pieces with moderate melting temperatures can also survive reentry, radiating heat over their large surface areas. Pieces that survive reentry tend to

be large and in some cases heavy, posing a significant hazard to people and property within the bounds of the object's reentry debris footprint. (Aerospace Corporation, Center for Orbital Reentry and Debris Studies, 2003) When possible, debris impact areas would be carefully selected to include deep ocean areas or designated locations on military ranges. However, the majority of orbital debris burns on reentry and thus does not reach the Earth. It is unlikely that the impact of debris associated with an uncontrolled reentry would pose a significant threat to the environment on Earth.

Debris that survives reentry would impact within debris or impact footprints, i.e., the areas on the land or water surfaces that would contain all of the debris pieces. Debris is more likely to terminate in water than on land because water covers 75 percent of the Earth's surface. Debris falling into water would produce impacts similar to those described for postlaunch activities in Alternative 1. It is possible to estimate the size of the impact footprint, but very difficult to predict precisely where the footprint would be on the Earth's surface or where specific pieces of debris would land. Exhibit 4-17 shows the various phases of reentry. After initial and subsequent breakups, surviving pieces of the reentering object would hit down in the debris or impact footprint area.

Exhibit 4-17. Typical Satellite Breakup



Source: Aerospace Corporation, Center for Orbital Reentry and Debris Studies, 2003

The size of the debris footprint is determined by estimating the breakup altitude of the orbiting object; then by estimating the mass and aerodynamic properties of surviving debris. Heavy debris would generally travel farther downrange within the debris footprint; lighter material would generally fall near the point of intercept. Footprint lengths can vary from 185 to 2,000 kilometers (115 to 1,243 miles), depending on the characteristics and complexity of the object.

The footprint width is generally determined by the impact of wind on the falling debris objects, with heavy objects less affected than lighter ones. The breakup process also may affect the width of the footprint. For example, if the object should explode during reentry, fragments would be spread out across the footprint. A footprint width of 20 to 40 kilometers (12 to 25 miles) is typical, with the most pronounced effects near the part of the footprint closest to the point of intercept. (Aerospace Corporation, center for Orbital Reentry and Debris Studies, 2003)

Upon termination of the useful life of a space-based weapon, the weapon and its platform would be deorbited in a controlled fashion. The deorbiting process for a space-based interceptor would not be different from deorbiting activities for other DoD or commercial objects on orbit. During the controlled deorbiting process, the interceptor and its platform would either be placed in a disposal orbit, which is normally 300 kilometers (186 miles) above geosynchronous orbit, or lowered through the atmosphere where, after experiencing the friction and heat of reentry, remaining debris would be deposited in a designated area of the ocean. The majority of the platform would be expected to burn upon reentry. The on-board chemicals would also burn, destroying them; therefore, they would not pose a threat to human health or the environment. The impacts associated with debris from deorbiting the weapon and its platform would be similar to the impacts of debris from postlaunch activities described in Alternative 1.

Debris from a successful intercept or a launch mishap resulting in the activation of an FTS would reenter the Earth's atmosphere in an uncontrolled manner. Missions are designed such that in the event of an FTS action by the flight safety officer, debris will reenter and impact either the BOA or on land on cleared ranges. It is also possible that during the planned deorbiting of a platform, the platform would experience a failure or lose communications with the ground controllers in which case the platform may reenter in an uncontrolled manner. In either scenario, the majority of the debris and platform would burn during reentry, resulting in a small amount, if any, inert debris reaching the Earth's surface.

4.2.1.1 Air Quality

Impacts from Launch/Flight

The air emissions associated with launching an interceptor from a space-based platform would be the same as those emitted during launch from any platform discussed in Alternative 1. However, emissions produced in a space environment would not affect the human environment; therefore, there would be no impact to air quality from space-based interceptors.

Impacts from Debris

Upon reentry, the majority of the space-based interceptor and its platform would burn due to the intense friction and heat created during reentry through the Earth's atmosphere. Any on-board hazardous materials would burn and would not pose a threat to human health or the environment. Some small particles and pieces of debris may serve as reaction sites for chemical reactions in the atmosphere; however, due to the infrequency of debris reentry and deorbiting events, the impacts would be insignificant.

4.2.1.2 Airspace

Impacts from Launch/Flight

Although launch of the interceptor would occur in space, the interceptor may be directed towards the Earth during intercepts and could impact the use of airspace in the interceptor's designated path. Any potentially affected airspace would be cleared before launch of the interceptor. Coordination with the appropriate FAA ARTCC and relevant military installations with responsibility for airspace management would minimize the potential for any adverse impacts to airspace use and scheduling.

Impacts from Debris

For controlled reentries, it would be possible to indicate an area of airspace that would need to remain cleared during reentry events. For uncontrolled reentries, current capabilities and procedures provide a limited ability to predict within a 30-minute, 9,656-kilometer (6,000-mile) window when and where a particular object would reenter the Earth's upper atmosphere. (U.S. Strategic Command, 2002) Given the difficulty in predicting the path of uncontrolled reentering space-based interceptors and their associated platforms, little advance warning could be given to clear airspace. However, most objects break up and vaporize under aerodynamic forces and heating that occur during reentry. Thus potential impacts to airspace are not expected to be significant.

4.2.1.3 Biological Resources

Impacts from Launch/Flight

The launch of interceptors from space-based platforms could result in impacts to biological resources. In the event that an intercept was attempted and was unsuccessful, the trajectory used by the interceptor could cause it to hit the Earth's surface. The trajectory for test events would be carefully selected such that the interceptor would impact in a cleared portion of the ocean or in a cleared military range. Also, space-based interceptors may be equipped with an FTS. In the event of a launch mishap, the FTS

would be activated to destroy the interceptor, which would further reduce impacts to biological resources.

Impacts from Debris

Upon reentry into the atmosphere, the majority of the interceptor and platform would be expected to break up and burn up due to the frictional forces and intense heat created upon reentry. Therefore, any on-board hazardous materials would also be consumed and would not pose a threat to biological resources. The remaining debris would fall to the Earth's surface and likely fall into open ocean waters where impact would be limited to fish and marine animals in the immediate surface waters surrounding the impact point. Fish and marine mammals at lower depths of the ocean would have more time to react to the sound of the impact and would be able to avoid the impact area.

Debris could potentially be scattered over a wide area. Factors affecting an object's path could include variations in the gravitational field of the landmass and ocean areas, solar radiation pressure, and atmospheric drag. Objects reentering may skip off the Earth's atmosphere, similar to a stone skipping across a pond, causing them to impact much further away than originally predicted and unintentionally disturbing wildlife and vegetation. (U.S. Strategic Command, 2002) The impacts of debris affecting biological resources would be similar to the impacts of postlaunch activities as described in Alternative 1.

4.2.1.4 Geology and Soils

Impacts from Launch/Flight

No impacts to geology and soils would be expected from the launch/flight of space-based interceptors.

Impacts from Debris

Because interceptor and station keeping platform propellants would likely be consumed during reentry into the upper atmosphere, debris and deorbiting activities for space-based weapons and their platforms would not be expected to release toxic substances that would impact soils.

The impact of debris from space-based weapons platforms or interceptors reaching the Earth's surface and creating craters or impacting unstable soils would be extremely unlikely, as most debris would not survive reentry. Debris that might survive reentry would likely be very small in size and would not create serious impact force on the surface. Further, when possible, debris impact areas would be carefully selected to include deep ocean areas or designated locations on military ranges, where impacts could

be contained. Because of the infrequency of debris reentry and the expected small size of surviving reentry debris, no significant impacts to geology or soils would be expected.

4.2.1.5 Hazardous Materials and Hazardous Waste

Impacts from Launch/Flight

The launch/flight of interceptors would not produce hazardous waste that would be transported to or disposed on Earth.

Impacts from Debris

Debris that is contaminated with hazardous materials would reenter the Earth's atmosphere and be exposed to high temperatures during reentry. This would likely render the debris inert by the time it reaches the Earth's surface. Debris and deorbited material would not be considered hazardous waste. Therefore, there would be no impact on hazardous waste management from space-based interceptor debris.

4.2.1.6 Health and Safety

Impacts from Launch/Flight

Launch trajectories would be selected such that, in the event of an unsuccessful intercept attempt, the debris from the interceptor launched from a space-based platform would impact in the open ocean area or in a designated area on land. This would minimize the possibility that health and safety of people on the ground would be affected by launch/flight activities. Also, space-based interceptors may be equipped with an FTS. In the event of a launch mishap, the FTS would be activated to destroy the interceptor, which would further reduce impacts to health and safety.

Impacts from Debris

Launch trajectories would be selected such that the debris from a space-based platform would impact in the open ocean area or in a designated area on land. This would minimize the possibility that health and safety of people on the ground would be affected by launch/flight activities. However, in the event of uncontrolled deorbiting, there is potential for the subsequent debris (devoid of any potentially harmful chemicals) to hit and injure humans. However, as mentioned above, humans only inhabit one-eighth of the Earth's surface; therefore, any impacts to health and safety expected from debris and deorbiting material would be minimal. The risk that an individual would be hit and injured by reentering orbital debris is estimated to be less than one in one trillion. As a reference point, the risk that an individual in the U.S. will be struck by lightning is approximately one in 1.4 million. Over the last 40 years, more than 1,400 metric tons

(1,543 tons) of material is estimated to have survived reentry with no reported casualties. (Aerospace Corporation, Center for Orbital Reentry and Debris Studies, 2003) Therefore, the impacts to health and safety expected from debris and deorbiting material would be negligible.

4.2.1.7 Noise

Impacts from Launch/Flight

No impacts from noise would be expected from the launch/flight of space-based interceptors.

4.2.1.8 Transportation

Impacts from Launch/Flight

There would be no impacts to transportation from launch/flight of space-based interceptors.

Impacts from Debris

Any orbital debris falling into the open ocean would most likely not be recovered. Debris recovery on land would be as described for Alternative 1, and would not have an impact on transportation.

4.2.1.9 Water Resources

Impacts from Launch/Flight

There would be no impacts to water resources from launch/flight of space-based interceptors.

Impacts from Debris

Upon reentry through the upper atmosphere, space-based interceptors and components would be subject to extreme heat, destroying residual chemicals or rendering them inert. Therefore, no impacts to water resources would be expected from debris and deorbiting material.

4.2.2 Test Integration

This section assesses the potential for environmental impacts of BMDS System Integration Test activities under Alternative 2.

Description of Tests Analyzed

The System Integration Tests would incorporate land-, sea-, air-, and space-based platforms for weapons, sensors, C2BMC, and support assets. The System Integration Test activities under Alternative 2 would be the same as those presented under Alternative 1.

In addition to the land-, sea-, and air-based interceptors described under Alternative 1, interceptors may be launched from space-based platforms under Alternative 2. All other activities and their associated impacts from System Integration Tests would be the same as those described under Alternative 1. GTs would not involve weapons components; however additional sensor and C2BMC components would be required to control and coordinate the activities of the four weapon platforms (land-, sea-, air-, and space-based) under Alternative 2. The System Integration Tests conducted under SIFT Scenarios 1 and 2 could include launches of interceptors from space-based platforms. Other aspects of these tests would be the same as described under Alternative 1.

Environmental Consequences

Component testing would continue under Alternative 2. These tests would be conducted in addition to the System Integration Tests described under Alternative 1; System Integration Tests conducted under Alternative 2 also could include the use of space-based interceptors. Space-based interceptors would replace a land-, sea-, or air-based weapon launch or activation. Space-based interceptors would be capable of providing defense against threat missiles in all flight phases.

Impacts from activities that are discussed earlier in this PEIS, including System Integration Tests using weapons from land-, air-, and sea-based platforms will not be discussed in this section. The analysis of System Integration Tests under Alternative 2 will focus on those environmental impacts that are unique to the use of space-based interceptors compared to those described for System Integration Test activities under Alternative 1.

The unique activities associated with each type of System Integration Test analyzed in this PEIS under Alternative 2 include

- **Integrated GTs**. The use of additional components to control and coordinate the activities of the four weapon platforms (land-, sea-, air-, and space-based).

- **SIFT Scenario 1 – Single Weapon with Intercept**. The launch of interceptors from space-based platforms with an intercept.

- **SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts**. The launch of multiple interceptors from multiple weapon platforms (land-, sea-, air-, and space-based) at up to two targets with intercepts. Under Alternative 2, the following analysis assumes that the launch of a space-based interceptor would replace a land-, sea-, or air-based weapon launch or activation. The use of support assets or C2BMC during test events is addressed under Alternative 1.

Tests Not Analyzed By Resource Area

- **Integrated GTs**. The use of additional components to control and coordinate the activities of a space-based interceptor would result in a negligible increase in the severity of the impacts across the resource areas presented under Alternative 1; therefore, impacts from GTs will not be considered further in this section.

- **SIFT Scenario 1 – Single Weapon with Intercept**. Under Alternative 2, the launch of the interceptor from a space-based weapon platform instead of a land-, sea-, or air-based platform as described under Alternative 1, would result in a negligible reduction (a beneficial change) in the overall impacts on each resource area. Under Alternative 2 an interceptor launch from a space-based weapon would replace the interceptor launch from a land- or sea-based weapon, which would result in a reduction in ground level emissions. Based on the projected target intercept flight path of a space-based interceptor, Alternative 2 may result in fewer impacts to airspace than Alternative 1. If the flight path were limited to the exoatmosphere, Alternative 2 would have fewer impacts to airspace than Alternative 1; however, if the flight path were directed towards Earth for an endoatmospheric intercept the impacts to airspace would be the same as for Alternative 1. The impacts of the launch of a space-based interceptor would be reduced for air quality, airspace, biological resources, geology and soils, hazardous materials and hazardous waste, health and safety, noise, transportation, and water resources. The impacts of the launch of a space-based interceptor are addressed in Section 4.2.2.10.

  The impacts due to debris from launching an interceptor from a space-based platform are not unique for either SIFT scenario. Launching an interceptor from a space-based platform could allow intercepts to occur at higher levels of the atmosphere than described under Alternative 1, but the impacts due to debris reentry would be the same as those discussed earlier in this PEIS.

Tests Analyzed by Resource Area

- **SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts**. The following sections present the environmental impacts, by resource area, for SIFT Scenario 2. For this programmatic analysis, a qualitative impact assessment for each resource area

was completed because specific System Integration Test parameters have not been developed that would provide quantitative values.

4.2.2.1 Air Quality

Under Alternative 2, there would be fewer impacts on air quality than under Alternative 1. Should an interceptor launch from a space-based weapon replace an interceptor launch from a land- or sea-based weapon, a reduction in ground level emissions would occur. If the activation of an air-based weapon were replaced, then a reduction in emissions would occur in the upper atmosphere (12,192 meters [40,000 feet]). The intercept would occur in the upper levels of the atmosphere, and would potentially occur in the exoatmosphere, where the majority of debris would burn upon reentry into the Earth's atmosphere.

4.2.2.2 Airspace

Under Alternative 2, there would be fewer impacts on airspace than under Alternative 1. Launch of an interceptor from space could result in a reduction in potential interference with airspace. Based on the projected target intercept flight path of a space-based interceptor, Alternative 2 may result in fewer impacts to airspace than Alternative 1. If the flight path is limited to the exoatmosphere, Alternative 2 would have fewer impacts to airspace than Alternative 1; however, if the flight path is directed towards Earth for an endoatmospheric intercept the impacts to airspace would be the same as for Alternative 1. Whether the intercept of a space-based weapon occurs in the endoatmosphere or exoatmosphere, the debris associated with an intercept of a space-based weapon would have the same impact on airspace as presented under Alternative 1. For exoatmospheric intercepts, the majority of the debris would burn upon reentry into the Earth's atmosphere; however, airspace would have to be cleared to allow for any debris from such an intercept to pass through the atmosphere to the surface of the Earth.

4.2.2.3 Biological Resources

Under Alternative 2, there would be fewer impacts on biological resources than under Alternative 1. Launch noise produced from a space-based interceptor would not reach the Earth. Therefore, tests under SIFT Scenario 2 would result in a reduction in noise and pollutant emissions associated with a launch or laser activation which could adversely affect biological resources. Specific impacts on biological resources would be related to threatened and endangered species, unique or sensitive environments, and migratory, breeding, and feeding activities that occur in an environment affected by such activities.

Coordination and consultation with appropriate regulatory agencies, as well as adherence to appropriate and relevant regulations would be required to address any potentially significant impacts on biological resources. Site-specific environmental analysis would be completed to evaluate such impacts.

4.2.2.4 Geology and Soils

The activities performed under Alternative 2 would not impact geology. Under Alternative 2, there would be fewer impacts on soil than under Alternative 1. If an interceptor launch from a space-based weapon would replace an interceptor launch from a land-based weapon there would be a reduction in ground level emissions; however, if launch of a sea- or air-based interceptor were replaced, there would be no change in the impact on soils.

4.2.2.5 Hazardous Materials and Hazardous Waste

Under Alternative 2, there would be fewer hazardous material and waste impacts than under Alternative 1. Fewer hazardous materials and hazardous waste would need to be disposed on Earth under Alternative 2. Such reductions would occur through the reduction of a launch or activation of a weapon from the human environment and the associated use of hazardous materials, and generation of hazardous waste. Because no impacts were identified under Alternative 1 from the increased use and generation of hazardous materials and hazardous waste, no significant impacts would be associated with Alternative 2.

4.2.2.6 Health and Safety

Under Alternative 2, there would be fewer health and safety impacts than under Alternative 1. Launching an interceptor from space rather than from land, air, or sea would result in a reduction in the number of individuals that would be exposed to health and safety risks associated with launch activities. Because no significant impacts were identified under Alternative 1 from the increased use and generation of hazardous materials and hazardous waste, no significant impacts would be expected from Alternative 2.

4.2.2.7 Noise

Under Alternative 2, there would be fewer noise impacts than under Alternative 1. Noise produced from the launch of interceptors from space-based platforms would not be audible on Earth. Because no significant impacts were identified under Alternative 1 from increased noise, no significant impacts would be expected from Alternative 2.

4.2.2.8 Transportation

The transportation impacts under Alternative 2 would be the same as the impacts under Alternative 1.

4.2.2.9 Water Resources

Under Alternative 2, there would be fewer impacts on water quality than under Alternative 1. An interceptor launch from a space-based weapon would replace an interceptor launch from a land-, sea-, or air-based weapon, which would result in a potential reduction in the debris and simulants that would reach a water resource based on the altitude where an intercept or flight termination would occur. Specific impacts on water resources are related to the unique or sensitive environments (wetlands, marine sanctuaries, essential fish habitat) that occur in the biome, which would be affected by such activities. Coordination and consultation with appropriate regulatory agencies, as well as adherence to appropriate and relevant regulations would be required to address any potentially significant impacts on water resources. Site-specific environmental analysis would be completed to evaluate potentially significant impacts.

4.2.2.10 Orbital Debris

- **SIFT Scenario 1 – Single Weapon with Intercep**t. Increases in orbital debris would be greater under Alternative 2 than under Alternative 1. Under Alternative 2 a higher proportion of the SIFT Scenario 1 tests would occur in the upper atmosphere because of testing associated with the space-based weapon. As defined under Alternative 1, the orbital debris would not pose a significant impact.

- **SIFT Scenario 2 – Multiple Weapons with Multiple Intercepts**. Increases in orbital debris would be greater under SIFT Scenario 2 than SIFT Scenario 1. Under SIFT Scenario 2 space-based interceptors, may be launched at a target in the upper atmosphere. As defined under Alternative 1, the orbital debris would not pose a significant impact.

4.2.3 Cumulative Impacts

As described for cumulative impacts from Alternative 1, worldwide launch programs for commercial, civil, and military programs were determined to be actions of international scope that could be appropriately considered for cumulative impacts in this PEIS. The impacts of worldwide launch programs were considered in the discussion of cumulative impacts for Alternative 1.

Alternative 2 includes placing weapons on all platforms considered for Alternative 1 (land, air, and sea) and placing weapons in space. The air emissions associated with launching interceptors from a space-based platform would be the same as those emitted during launch from any platform discussed in Alternative 1. However, emissions produced in a space environment would not affect the human environment; therefore, the cumulative impacts analysis for Alternative 2 does not address the additive impacts of emissions produced by launches from a space-based platform. Placing weapons in space

involves adding additional structures to space for extended periods of time; therefore, it is appropriate to include in this cumulative impacts analysis other programs that are international in scope which place structures in space for extended periods of time. The International Space Station (ISS) was determined to be an action that is international in scope and has a purpose of placing structures in space for extended periods of time. Therefore the cumulative impacts analysis for Alternative 2 encompasses the discussion of worldwide launch programs as discussed for Alternative 1 and includes a discussion of the impacts of the proposed BMDS in conjunction with the ISS.

The ISS is a collaborative project including contributions from 27 countries worldwide. As originally designed, the ISS would have a mass of about 471,736 kilograms (1,040,000 pounds) and would measure 109 meters (356 feet) across and 88 meters (290 feet) long, with almost an acre of solar panels. (ISS, 1999) The first piece of the ISS was placed into orbit on November 20, 1998; the ISS is still under construction and therefore the current orbiting structure does not meet the dimensions described above. However, the ISS the largest single human-made structure currently orbiting in space.

The ISS maintains an orbit around the Earth. The ISS and other man-made orbiting objects can be adversely affected by orbital debris. Orbital debris is produced during orbital launches and would be produced during some proposed BMDS test events and activities including those used to place space-based weapons on orbit. If the orbital debris produced during BMDS activities was located in orbits on the same plane or higher than the ISS the potential would exist for orbital debris to impact the ISS. The extent of the impact of orbital debris on structures depends on the size of the debris and the velocity at which it is traveling.

Debris as small as a fleck of paint approximately 0.02 centimeter (0.008 inches) in diameter traveling at a velocity of three to six kilometers per second (two to four miles per second) has been documented to create a 0.5 centimeter (0.2 inch) indention in the windshield of the Space Shuttle. In LEO, an aluminum sphere 0.13 centimeter (0.05 inch) in diameter has damage potential similar to that of a .22-caliber long rifle bullet. An aluminum sphere one centimeter (0.4 inch) in diameter is comparable to a 181-kilogram (400-pound) safe traveling at 97 kilometers per hour (60 miles per hour). A fragment 10 centimeters (3.9 inches) long is roughly comparable to 25 sticks of dynamite. In general, debris smaller than 0.1 centimeter (0.04 inch) in size does not pose a hazard to spacecraft functionality. Debris from 0.1 centimeter (0.04 inch) to one centimeter (0.4 inch) in size may or may not penetrate a spacecraft, depending on material and whether shielding is used. However, penetration through a critical component, such as the flight computer or propellant tank, can result in loss of the spacecraft. Debris fragments between one and 10 centimeters (0.4 and 3.9 inches) in size will penetrate and damage most spacecraft. Astronauts or cosmonauts engaging in extra-vehicular activities could be vulnerable to the impact of small debris. On average, debris

1 millimeter (0. 04 inch) is capable of perforating current U.S. space suits. (Cour-Palais, 1991, as referenced in Commission on Engineering and Technical Systems, 1995)

In general, any orbital debris produced by BMDS activities would likely be small, primarily consisting of explosive bolts and small pieces of hardware. It may also be possible for debris related to an intercept to become orbital debris. However, because the majority of BMDS activities would occur in LEO where debris would gradually drop into successively lower orbits and eventually reenter the atmosphere, the debris would not be a significant hazard to the ISS. As BMDS testing becomes more realistic, there is potential for an increased amount of debris reaching and remaining on orbit. Most of this debris would likely not remain on orbit for more than one revolution, and eventually all of the debris would de-orbit. NASA and its ISS partners may be able to implement mitigation strategies to further reduce the impacts to the ISS from orbital debris. NASA and the U.S. Air Force Space Command monitor orbiting space objects and are aware of instances when the ISS is predicted to be in proximity to space debris that has the potential to damage spacecraft.

MDA would evaluate risk to existing space assets prior to test launches as indicated in Appendix L Orbital Debris. MDA would use launch window screening and schedule tests to eliminate risk of BMDS intercept debris impacting the ISS. Because the debris produced by BMDS activities would be expected to be small and would eventually be removed from orbit, and MDA would schedule launches to avoid the ISS, there would be no significant impacts expected to the ISS from the implementation of Alternative 2 for the BMDS PEIS.

4.3 No Action Alternative

Under the No Action Alternative, the MDA would not develop, test, deploy, or plan for decommissioning activities for an integrated BMDS. Instead, the MDA would continue existing test and development of individual missile defense systems as stand-alone capabilities. Under the No Action Alternative, individual components would continue to be tested to determine the adequacy of their stand-alone capabilities, but they would not be subjected to System Integration Tests. Further, C2BMC architecture would be designed to meet individual components needs and would not be designed or tested to meet the needs of an integrated system. The No Action Alternative would not allow for the effective development of an integrated BMDS to defend against threat missiles in all flight phases.

The No Action Alternative involves the continuation of current MDA activities for individual weapons, sensors, C2BMC, and support assets and would not include integration or System Integration Testing of these components. For the potential sites being considered for deployment, the No Action Alternative would be a continuation of activities currently occurring or planned at those locations. Therefore, the environmental

impacts associated with the No Action Alternative would be the same as the impacts resulting from existing activities assuming no integration. Because System Integration Testing would not occur under the No Action Alternative, the impacts associated with this testing would not occur.

The decision not to develop and field a fully integrated BMDS could result in the inability to respond to a ballistic missile attack on the U.S. or its deployed forces, allies, or friends in a timely and successful fashion. Further, the No Action Alternative would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress.

4.4 Adverse Environmental Effects That Cannot Be Avoided

Adverse environmental effects that cannot be avoided include the removal of vegetation during site preparation and construction activities; minor short-term noise impacts startling of wildlife; deposition of small amounts of pollutants on land, air, and sea; minor increased generation of hazardous materials; and emission of EMR.

In general, most known adverse effects resulting from implementation of the BMDS would be mitigated through project planning and design measures, consultation with appropriate agencies, and the use of Best Management Practices. As a result, most potential adverse effects would be avoided and those that could not be avoided should not result in a significant impact to the environment. Consultation with the appropriate agencies would result in the development of mitigation measures needed to ensure that impacts remain at less than significant levels.

4.5 Relationship between Short-Term Use of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

Section 1502.16 of the CEQ NEPA Implementing Regulations; require that the relationship between short-term uses of the human environment and the maintenance and enhancement of long-term productivity be discussed.

Proposed BMDS activities would take advantage of existing facilities and infrastructure to the extent practicable. The implementation of the BMDS would not necessarily preclude the use of facilities and infrastructure for other purposes. Therefore, options for future use would not be eliminated.

4.6 Irreversible or Irretrievable Commitment of Resources

Implementing the BMDS would not be expected to result in the loss of threatened or endangered species or cultural resources. However, some irretrievable resources would be used (e.g., construction materials, fuel, and labor). Site preparation and construction activities would result in some minor loss of biological habitat and wetlands, but impacts

would be minimized through the implementation of mitigation measures. Sensitive biological habitat would be avoided to the extent practicable. Proposed BMDS activities would not irreversibly curtail the range of potential uses of the environment. There would be no preclusion of development of underground mineral resources that were not already constrained.

Although the proposed BMDS activities would result in some irreversible or irretrievable commitment of resources such as various construction materials, minerals, and labor, this commitment of resources is not significantly different from that necessary for many other defense research and development programs carried out over the past several years. Proposed activities would not commit natural resources in significant quantities.

4.7 Federal Actions to Address Protection of Children from Environmental Health Risks and Safety Risks (EO 13045, as Amended by EO 13296 and EO 13229)

This PEIS has not identified any environmental health and safety risks that may disproportionately affect children, in compliance with EO 13045 as amended by EO 13229.

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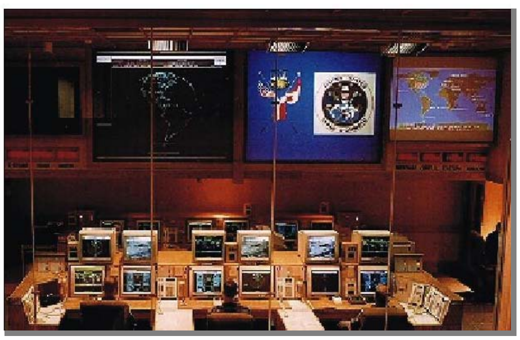

Programmatic Environmental Impact Statement

January 2007

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Department of Defense
Missile Defense Agency
7100 Defense Pentagon
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ACRONYMS AND ABBREVIATIONS

ABL	Airborne Laser
ADHD	Attention-deficit-hyperactivity disorder
AFB	Air Force Base
AFSPC	U.S. Air Force Space Command
Al_2O_3	Aluminum Oxide (alumina)
ANSI	American National Standards Institute
ASIP	Arrow System Improvement Program
BRAC	Base Realignment and Closure
BMD	Ballistic Missile Defense
BMDO	Ballistic Missile Defense Organization
BMDS	Ballistic Missile Defense System
BOA	Broad Ocean Area
C2BMC	Command and Control, Battle Management, and Communications
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CTF	Combined Test Force
dB	Decibel
dBA	A-weighted decibel
DISCOS	Database and Information System Characterizing Objects in Space
DNL	Day Night Average Noise Level
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
EA	Environmental Assessment
EDWC	Estimated Drinking Water Concentrations
EIS	Environmental Impact Statement
EM	Electromagnetic
EMR	Electromagnetic Radiation
EO	Executive Order
EPA	Environmental Protection Agency
ETR	Extended Test Range
FAA	Federal Aviation Administration
FR	Federal Register
GBI	Ground-Based Interceptor
GEO	Geosynchronous Earth Orbit
GHz	Gigahertz
GIS	Geographic Information System
GMD	Ground-Based Midcourse Defense
HAP	Hazardous Air Pollutant
HF	High frequency
ICBM	Inter-Continental Ballistic Missile

IDOC	Initial Defensive Operations Capability
IDO	Initial Defensive Operations
IEEE	Institute of Electrical and Electronics Engineers
INF	Intermediate-Range Nuclear Forces
IPSC	Interagency Perchlorate Steering Committee
ISS	International Space Station
IWG	Interagency Working Group
KEI	Kinetic Energy Interceptor
KLC	Kodiak Launch Complex
kW	Kilowatts
L_{eq}	Equivalent Noise Level
LC_{50}	Lethal Concentration for 50 percent
LEO	Low Earth Orbit
LOAEL	Lowest Observed Adverse Effect Level
MDA	Missile Defense Agency
MEO	Medium Earth Orbit
mg/kg	Milligrams per kilogram
MHz	Megahertz
MPE	Maximum Permissible Exposure
MSL	Mean Sea Level
MSX	Midcourse Space Experiment
mW	Megawatts
mW/cm^2	Milliwatts per square centimeter
NASA	National Aeronautics and Space Administration
NAS	National Academy of Science
NEPA	National Environmental Policy Act
NEXRAD	Next Generation Weather Radar
NFIRE	Near-Field Infrared Experiment
NMD	National Missile Defense
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NOEL	No Observed Effect Level
NOHD	Nominal Ocular Hazard Distance
NOTAM	Notice to Airmen
NRC	National Research Council
NRO	National Reconnaissance Organization
OCONUS	Outside the Continental United States
OSTP	Office of Scence and Technology Policy
PAC-3	PATRIOT Advanced Capability-3
PAVE PAWS	Position and Velocity Extraction Phased Array Warning System
PEIS	Programmatic Environmental Impact Statement
ppb	parts per billion
ppm	parts per million

PMRF	Pacific Missile Range Facility
POD	Point of Departure
PRST	Pacific Range Support Team
RCC	Range Commanders' Council
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
ROD	Record of Decision
SAR	Specific absorption rate
SBIRS	Space-Based Infrared Sensor
SBX	Sea-Based X-Band Radar
SEL	Sound Exposure Level
SHEL	Surrogate High Energy Laser
SRM	Solid Rocket Motor
SSN	Space Surveillance Network
START	Reduction and Limitation of Strategic Offensive Arms Treaty
STEPAL	System Test and Evaluation Planning Analysis Lab
T3	Triiodothyronine
T4	Thyroxine
THAAD	Terminal High Altitude Area Defense
TSH	Thyroid stimulating hormone
UF	Uncertainty factors
UHF	Ultrahigh frequency
U.S.	United States
USAF	United States Air Force
USFWS	United States Fish and Wildlife Service
U.S.C.	United States Code
USGS	United States Geological Survey
USSTRATCOM	United States Strategic Command
USSPACECOM	United States Space Command
VHF	Very high frequency
V/m	Volts per meter
VOC	Validation of Operational Concept
W/kg bw	Watts per kilogram body weight
XBR	X-Band Radar

APPENDIX K
COMMENT RESPONSE

COMMENT RESPONSE

Introduction

The Missile Defense Agency (MDA) received approximately 8,500 comment documents on the Draft Ballistic Missile Defense System (BMDS) Programmatic Environmental Impact Statement (PEIS). These comment documents were received via phone (0.14 percent), facsimile (0.08 percent), e-mail and through the electronic form available on the BMDS PEIS web site (5 percent), and mail (94 percent). To further facilitate public comment, the MDA held four public hearings

- October 14, 2004, Arlington, Virginia;
- October 19, 2004, Sacramento, California;
- October 21, 2004, Anchorage, Alaska; and
- October 26, 2004, Honolulu, Hawaii.

Both oral and written comments were received at the hearings constituting 0.70 and 0.14 percent, respectively, of the total comments.

Methodology for Considering Comments and Comment Documents

A comment document is defined as a document that is submitted by a commenter (e.g., letter, postcard, e-mail, telephone message, oral comment at the public hearing, etc.), and a comment is defined as a distinct statement or question about a particular topic. A comment document may contain several comments. The MDA logged in and assigned individual numbers to each comment document based on how the comment document was received. Comment documents are numbered as follows.

- Phone – DC_P0001
- Facsimile – DC_F0001
- E-mail/Web site – DC_E0001
- Mail – DC_M0001
- Public Hearing Oral – DC_PHO0001
- Pubic Hearing Written – DC_PHW0001
- Other – DC_O0001

Comment document numbers are listed in Exhibit K-1, which is organized alphabetically by commenter name. All comment documents received during the comment period were given equal consideration during preparation of the Final PEIS, regardless of the delivery method or commenter.

When public comments are large in number and volume, the National Environmental Policy Act (NEPA) does not require Federal agencies to reprint all written comments in

the Final Environmental Impact Statement (EIS). However, all comments must be considered in preparing the Final EIS. Council on Environmental Quality (CEQ) guidance states "if a number of comments are identical or very similar, agencies may group the comments and prepare a single answer for each group. Comments may be summarized if they are especially voluminous. The comments or summaries must be attached to the EIS regardless of whether the agency believes they merit individual discussion in the body of the final EIS."[1] For this PEIS, MDA included full text copies of all comment documents containing comments considered within the scope of the PEIS and specifically identified the comments requiring responses.

Template Letters

In sorting comment documents, MDA identified four distinct template letters that were submitted via e-mail, facsimile, or regular mail. These template letters, which are classified as Comment Template A, B, C, and D, are discussed in Section K.2. There were some variations of these template letters; therefore, Section K.2 provides randomly selected copies of variations of each of the four template letters.

Out of Scope Comments

NEPA requires Federal agencies to focus analysis and documentation on the significant issues related to a proposed action. Many of the comments received on the Draft PEIS were declarative statements not requiring a direct response, but which did need to be noted in the context of overall public review. Some of the comments received were related to budgetary or policy issues such as system cost, potential threat, and system effectiveness. These comments are considered outside the scope of this PEIS and require no revision to the PEIS and no direct response, except to note the comments for the record.

Section K.3 summarizes out of scope comments and provides the reasons why these comments do not require a substantive response. It should be noted that all comments were considered and the text of all comments and comment documents are included in the administrative record for the PEIS.

Comment Documents Containing In Scope Comments

Comment documents that contained substantive comments that were determined to be within the scope of this PEIS were identified. These comment documents are reproduced in Section K.4. In general, comments that addressed the resource areas analyzed in the Draft BMDS PEIS, feasible alternatives, relevant laws and regulations, and specific

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[1] CEQ, Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations, March 16, 1981. (46 *FR* 18026, March 23, 1981, as amended in 51 *FR* 15618, April 25, 1986)

comments relating to the impacts analysis, were considered to be within the scope of the PEIS.

Section K.4 includes reproductions of the original comment documents containing in-scope comments that were received during the public comment period for the Draft BMDS PEIS. Section K.4 also includes relevant excerpts of the in-scope comments and a response to each. Where appropriate, revisions to the Final BMDS PEIS were made to address these comments.

Comments Submitted by Federal Agencies

Several comment documents were submitted by Federal agencies, such as the United States (U.S.) Environmental Protection Agency (EPA) and the Department of the Interior. These comment documents are reproduced in Section K.5. Section K.5 also includes responses to each comment. Where appropriate, revisions to the Final BMDS PEIS were made to address these comments.

K.1 Summary of Commenters

It is important that each commenter be able to clearly identify that their comments were considered and where and how their comments were addressed. Exhibit K-1 organizes all comment documents by commenter name, comment document number, commenter organization, and section in this Appendix where specific comments from each comment document are addressed. As noted earlier, template letters are addressed in Section K.2, out of scope comments are addressed in Section K.3, in-scope comments are addressed in Section K.4, and comments submitted by Federal agencies are addressed in Section K.5. This exhibit is organized alphabetically by commenter's last name. If multiple signatures were provided on a comment document, the comment document is listed under the first signatory's name.

Exhibit K-1. Location of Responses to Comments

Last Name	First Name	Additional Commenters	Comment Document Number	Commenter Organization	Subsection Where Comment is Addressed
"Not Given"	"Not Given"		DC_E0054		K.3.4, K.3.6, K.3.11, K.3.15
"Not Given"	"Not Given"		DC_E0064		K.3.2, K.3.10, K.3.12
"Not Given"	"Not Given"		DC_E0079		K.3.1
"Not Given"	"Not Given"		DC_E0163		K.3.14
"Not Given"	"Not Given"		DC_E0188		K.3.4, K.3.5, K.3.11, K.3.12, K.3.15
"Not Given"	"Not Given"		DC_E0240		K.3.12, K.3.15
"Not Given"	"Not Given"		DC_E0289	Sisters of Saint Joseph	K.3.12
"Not Given"	"Not Given"		DC_E0362		K.3.1, K.3.2, K.3.10, K.3.12, K.3.13, K.3.15
"Not Given"	Angie		DC_M0711	UCS	K.2.1
"Not Given"	Kerri		DC_E0049		K.3.1
"Not Given"	Murray		DC_E0261		K.3.2, K.3.4, K.3.12
"Not Given"	Peggy		DC_E0053		K.3.2, K.3.3, K.3.12
"Not Given"	Ruth		DC_M0054		K.3.3, K.3.12
"Not Given"	Sarah		DC_E0436		K.3.1, K.3.3, K.3.7, K.3.10
"Not Given"	Tane		DC_E0014		K.3.1
A	Barbara		DC_M3469	UCS	K.2.1
Aaron	Frank		DC_M7911	UCS	K.2.1
Abbot	Rachel		DC_M0056	UCS	K.2.1
Abbott	Elizabeth		DC_M0178	UCS	K.2.1
Abbott	Julie		DC_M7118	UCS	K.2.1
Abbott	Lynn		DC_M0652	UCS	K.2.1
Abrahamson	Mary		DC_M4850	UCS	K.2.1
Abram	Natalie		DC_M7020	UCS	K.2.1
Abramis	David		DC_M5227	UCS	K.2.1
Abricka	M.		DC_M5434	UCS	K.2.1
Acerro	Theresa		DC_M2481	UCS	K.2.1
Achee	Kristie		DC_M1072	UCS	K.2.1
Achin	Ginny		DC_M7817		K.2.3
Ackard	Christian		DC_M4135	UCS	K.2.1
Acker	John		DC_M7886	UCS	K.2.1
Acker	Lois		DC_M1891	UCS	K.2.1
Acker	Nancy		DC_M5883	UCS	K.2.1
Acker	Nancy		DC_M6321	UCS	K.2.1
Acker	Nancy		DC_M6404	UCS	K.2.1
Ackerman	Beverly		DC_M2331	UCS	K.2.1
Adam	Geoffrey		DC_M2034	UCS	K.2.1
Adam	Geoffrey		DC_M2035	UCS	K.2.1
Adame	Leonard		DC_M7243	UCS	K.2.1
Adame	M. Nicole		DC_M1817	UCS	K.2.1
Adams	Evelyn		DC_M0343	UCS	K.2.1
Adams	Gary		DC_M3850	UCS	K.2.1
Adams	Gloria		DC_E0003		K.2.2
Adams	Gordon		DC_M1989	UCS	K.2.1
Adams	Jon		DC_M1772	UCS	K.2.1
Adams	Kate		DC_M7821		K.2.3
Adams	Lily		DC_M4449	UCS	K.2.1
Adams	Steve		DC_M6577	UCS	K.2.1
Adams	Winn		DC_M6356	UCS	K.2.1
Adams	Spencer		DC_M5868	UCS	K.2.1
Adams-Welch	Koren		DC_M0334	UCS	K.2.1
Adams-Welch	Koren		DC_M0393	UCS	K.2.1
Adams-Welch	Koren		DC_M5866	UCS	K.2.1
Adams-Welch	Koren		DC_M6833	UCS	K.2.1
Ader	James		DC_M6934	UCS	K.2.1
Adler	Ashley		DC_M3827	UCS	K.2.1
Adler	Barbara		DC_M2705	UCS	K.2.1

Exhibit K-1. Location of Responses to Comments

Last Name	First Name	Additional Commenters	Comment Document Number	Commenter Organization	Subsection Where Comment is Addressed
Admson	Colby		DC_M1886	UCS	K.2.1
Adney	Vicki		DC_M3832	UCS	K.2.1
Affsprung	Bruce		DC_M7920	UCS	K.2.1
Agee	Joel		DC_M3265	UCS	K.2.1
Agell	Charlotte		DC_E0174		K.3.7, K.3.12
Aggetta	Daryn		DC_M0402		K.2.1
Aghamiri	Rasoul		DC_M1338	UCS	K.2.1
Agius	Brad		DC_M3915	UCS	K.2.1
Agosto	Maria		DC_M6343	UCS	K.2.1
Aguilar	Fernando		DC_M3711	UCS	K.2.1
Ahearn	John		DC_M6980	UCS	K.2.1
Ahern	Doreen Ann		DC_M1877	UCS	K.2.1
Ahern	Larry		DC_M5409	UCS	K.2.1
Aherns	Tim		DC_M5505	UCS	K.2.1
Ahlin	Maria		DC_M4794	UCS	K.2.1
Aisha	Mashariki		DC_M5364	UCS	K.2.1
Aissatou	Djinguui		DC_M6257	UCS	K.2.1
Aitken	Gloria S		DC_M3232	UCS	K.2.1
Akelian	Lorraine		DC_M4574	UCS	K.2.1
Aker	Rebecca		DC_M3656	UCS	K.2.1
Akom	Denise		DC_M3447	UCS	K.2.1
Akram	Raisa		DC_M4657	UCS	K.2.1
Alam	Zena		DC_M6020	UCS	K.2.1
Alber	Catherine R.		DC_M2837	UCS	K.2.1
Albertini	John		DC_M6904	UCS	K.2.1
Albertson	Russell		DC_M5865	UCS	K.2.1
Albin	Woodrow		DC_M1625	UCS	K.2.1
Albu	Raluca		DC_M4132	UCS	K.2.1
Alcorn	Margaret D		DC_M0648		K.2.1
Alderfer	JoAnne		DC_M1359	UCS	K.2.1
Aldrich	Stanley		DC_M6567	UCS	K.2.1
Alenick	Colman		DC_M4317	UCS	K.2.1
Alexander	Janet T.		DC_M5467	UCS	K.2.1
Alexander	Jennifer		DC_M2642	UCS	K.2.1
Alexander	Jill		DC_M1811	UCS	K.2.1
Alexander	Laura		DC_M7370	UCS	K.2.1
Alexander	Mary		DC_M5352	UCS	K.2.1
Alexander-Brown	Karen		DC_M2904	UCS	K.2.1
Alexandra	Radbil		DC_M3377	UCS	K.2.1
Ali	Sheila		DC_M3804	UCS	K.2.1
Alicie	Lori		DC_M1513	UCS	K.2.1
Alitoto	P.		DC_M7142	UCS	K.2.1
Allan	Annie		DC_M2856	UCS	K.2.1
Allard	Diana		DC_M6142	UCS	K.2.1
Alldredge	Debra		DC_M1268	UCS	K.2.1
Allee	Pam		DC_M7839		K.2.3
Allemayehw	Louis		DC_M4189	UCS	K.2.1
Allen	C. E.		DC_M5938	UCS	K.2.1
Allen	Caron		DC_M4306	UCS	K.2.1
Allen	Delbert		DC_M1565	UCS	K.2.1
Allen	Helen		DC_M5548	UCS	K.2.1
Allen	Jennifer		DC_M4694	UCS	K.2.1
Allen	Jeremy		DC_M6140	UCS	K.2.1
Allen	Peter		DC_M5401	UCS	K.2.1
Allen	S.O.		DC_M6619	UCS	K.2.1
Allen	Tammy		DC_M3599	UCS	K.2.1
Allen	Vinit		DC_M6807	UCS	K.2.1
Allen	Dennis		DC_M1963	UCS	K.2.1
Allenson	Herbert		DC_M1889	UCS	K.2.1

Exhibit K-1. Location of Responses to Comments

Last Name	First Name	Additional Commenters	Comment Document Number	Commenter Organization	Subsection Where Comment is Addressed
Allerton	George		DC_M5807	UCS	K.2.1
Allgood	Clarice		DC_M0280		K.2.1
Allison	Alix		DC_M6256	UCS	K.2.1
Allison	Jennifer		DC_M7247	UCS	K.2.1
Allison	Michael		DC_M1024	UCS	K.2.1
Allison	Sue		DC_M1892	UCS	K.2.1
Allred	Frances		DC_M3859	UCS	K.2.1
Alongi	Shelley		DC_M4032	UCS	K.2.1
Alpern	Robert		DC_PHO0007		K.3.1, K.3.2, K.3.3, K.3.4, K.3.11, K.3.13, K.3.15, K.4
Alpert	Emily		DC_M2739	UCS	K.2.1
Alsdorf	Henrietta		DC_M7333	UCS	K.2.1
Alston	Michaelene		DC_M1047	UCS	K.2.1
Altamura	Gina		DC_M5992	UCS	K.2.1
Altepeter	Michelle		DC_M3214	UCS	K.2.1
Alter	Judith		DC_M4983	UCS	K.2.1
Altman	Harold		DC_M0070		K.2.1
Alton	Adele		DC_M2895	UCS	K.2.1
Alukonis	Maryann		DC_M5995	UCS	K.2.1
Alukonis	Maryann		DC_M7389	UCS	K.2.1
Alvarez	Charles		DC_M1377	UCS	K.2.1
Alvarez-Jett	Rachael		DC_M2319	UCS	K.2.1
Alvear	Elsa		DC_M3590	UCS	K.2.1
Alves	Mary		DC_E0291		K.3.12
Aman	Mark		DC_M4318	UCS	K.2.1
Amandes	Sarah		DC_M5045	UCS	K.2.1
Amar	Andrea		DC_M5199	UCS	K.2.1
Ambrose	Kenneth		DC_M4675	UCS	K.2.1
Ambrose	Kenneth		DC_M6120	UCS	K.2.1
Ambrosia	Joe		DC_M3485	UCS	K.2.1
Ambrosini	Jacqueline		DC_M2556	UCS	K.2.1
Ames	Diane		DC_M1603	UCS	K.2.1
Amigon	Gudelia		DC_M3683	UCS	K.2.1
Amir	Berj		DC_M7500	UCS	K.2.1
Ammerman	Seth		DC_M2143	UCS	K.2.1
Ammon	Gregory		DC_M6398	UCS	K.2.1
Amnotte	David		DC_M3128	UCS	K.2.1
Amodio	Richard		DC_M2464	UCS	K.2.1
Amos	Jerry		DC_M1124	UCS	K.2.1
Anacleto	Dottie		DC_M4573	UCS	K.2.1
Anapol	Sherry		DC_M0189		K.2.1
Ancel	Joseph		DC_M2001	UCS	K.2.1
Anders	Tisa		DC_E0229	Executive Director New Foundations Nonviolence Center	K.2.2
Anderson	Cara		DC_M1969	UCS	K.2.1
Anderson	Carol		DC_M1868	UCS	K.2.1
Anderson	Charles		DC_M7022	UCS	K.2.1
Anderson	Charles E		DC_M2160	UCS	K.2.1
Anderson	Clifford		DC_M2322	UCS	K.2.1
Anderson	Constance		DC_M1743	UCS	K.2.1
Anderson	Constance		DC_M2330	UCS	K.2.1
Anderson	Contance		DC_M6529	UCS	K.2.1
Anderson	Debra		DC_M7396	UCS	K.2.1
Anderson	Jean		DC_M5734	UCS	K.2.1
Anderson	Joanne M.		DC_M7642	UCS	K.2.1
Anderson	Katherine		DC_M5027	UCS	K.2.1
Anderson	Meghan		DC_M1440	UCS	K.2.1
Anderson	Michelle		DC_M2788	UCS	K.2.1

Last Name	First Name	Additional Commenters	Comment Document Number	Commenter Organization	Subsection Where Comment is Addressed
Anderson	Paul		DC_M4787	UCS	K.2.1
Anderson	Rebekah		DC_M6856	UCS	K.2.1
Anderson	Richard		DC_M0380		K.2.1
Anderson	Ruth		DC_M1879	UCS	K.2.1
Anderson	Ruth		DC_M3297	UCS	K.2.1
Anderson	Susan		DC_M1405	UCS	K.2.1
Anderson	Trisha		DC_M0925	UCS	K.2.1
Anderson	William		DC_M7770		K.2.1
Andrade	Paul S.		DC_M6606	UCS	K.2.1
Andrade	Paul S.		DC_M6618	UCS	K.2.1
Andre	Terry		DC_M1606	UCS	K.2.1
Andree	William		DC_M6837	UCS	K.2.1
Andree	William		DC_M7173	UCS	K.2.1
Andres	Thomas		DC_M2737	UCS	K.2.1
Andrew	David		DC_M7875		K.2.1
Andrew	Mark		DC_M3783	UCS	K.2.1
Andrews	Mary Anne		DC_M0384		K.2.1
Andrews	Michael		DC_M6118	UCS	K.2.1
Andrews	Theresa		DC_M4165	UCS	K.2.1
Andrews	Robert		DC_M7622	UCS	K.2.1
Andrus	Tom		DC_M1626	UCS	K.2.1
Anelli	Darla		DC_M7166	UCS	K.2.1
Anetakos	Mary		DC_M6077	UCS	K.2.1
Angell	Donald A.		DC_M3346	UCS	K.2.1
Angell	Donald A.		DC_M3879	UCS	K.2.1
Anhalt	Kimberly		DC_M5113	UCS	K.2.1
Annabel	Abrams		DC_M3890	UCS	K.2.1
Ano	Marion		DC_PHO0052		K.3.12
Ansevin	Allen		DC_M2812	UCS	K.2.1
Anthoney	Terence		DC_M4836	UCS	K.2.1
Antilla	Liisa		DC_M1508	UCS	K.2.1
Antoinette	Palmieri		DC_E0354	New Target Inc (client: missiledefenseadvocacy.org	K.3.9
Anton	Liz		DC_M2744	UCS	K.2.1
Anweiler	Bryan		DC_M5283	UCS	K.2.1
Appelbaum	Matthew		DC_M4064	UCS	K.2.1
Applegate	Boyd		DC_M7900		K.2.1
Aquilino	Christine		DC_M4153	UCS	K.2.1
Arand	William		DC_M3319	UCS	K.2.1
Aranita	Rosita		DC_M0826	UCS	K.2.1
Archard	Albert		DC_M2239	UCS	K.2.1
Archer	Benedict		DC_M5663	UCS	K.2.1
Ardinger	Nick		DC_M6001	UCS	K.2.1
Ard-Kelly	Sonya		DC_M2982	UCS	K.2.1
Arena	Andrea		DC_M4276	UCS	K.2.1
Argabright	Carol		DC_M5143	UCS	K.2.1
Argani	Sholey		DC_M4857	UCS	K.2.1
Arias	Eve		DC_E0260		K.3.1, K.3.3, K.3.12, K.3.15
Arias-Moffett	Martha		DC_M5121	UCS	K.2.1
Arikat	Amin		DC_M1535	UCS	K.2.1
Arkitekter	Urban Rabbe		DC_E0390		K.2.2
Armistead	Susan		DC_M2095	UCS	K.2.1
Armistead	Susan		DC_M6290	UCS	K.2.1
Armstrong	Ambre		DC_M1804	UCS	K.2.1
Armstrong	Desmond		DC_M7726		K.2.1
Armstrong	Joseph		DC_M3144	UCS	K.2.1
Armstrong	Keira		DC_M2671	UCS	K.2.1

Last Name	First Name	Additional Commenters	Comment Document Number	Commenter Organization	Subsection Where Comment is Addressed
Armstrong	Marilee		DC_M7931		K.2.1
Armstrong	Mary		DC_M0224		K.3.14
Arnaout	Maya		DC_M3946	UCS	K.2.1
Arnemann	Cheryl		DC_M1851	UCS	K.2.1
Arnold	Carl		DC_M5070	UCS	K.2.1
Arnold	Gregory		DC_M4547	UCS	K.2.1
Arnold	John		DC_M6092	UCS	K.2.1
Arnold	John D.		DC_M6114	UCS	K.2.1
Arnold	Michelle		DC_M3868	UCS	K.2.1
Aronson	Marsha		DC_M6820	UCS	K.2.1
Aronson	Sylvia		DC_M4258	UCS	K.2.1
Arp-Adams	Heidi		DC_M2043	UCS	K.2.1
Arrington	Hillary		DC_M2860	UCS	K.2.1
Arrington	Julie		DC_M1690	UCS	K.2.1
Arroe	Cate		DC_M4359	UCS	K.2.1
Artley	Richard		DC_M7694		K.2.1
Arts	Tristan		DC_M0986	UCS	K.2.1
Arumugham	Vinu		DC_M3086	UCS	K.2.1
Arvin	Patricia		DC_M0875	UCS	K.2.1
Asbury	Craig		DC_M6402	UCS	K.2.1
Ashburn	James		DC_M2664	UCS	K.2.1
Ashley	Carol		DC_M2249	UCS	K.2.1
Ashley	Micheal		DC_M2898	UCS	K.2.1
Ashton	Linda		DC_M0903	UCS	K.2.1
Ashton	Linda		DC_M5342	UCS	K.2.1
Asselin	David		DC_M2414	UCS	K.2.1
Atayan	Sami		DC_M6037	UCS	K.2.1
Athanasiadis	Stefan		DC_M6369	UCS	K.2.1
Atkins	Ed		DC_M6897	UCS	K.2.1
Atkinson	Martha		DC_M4586	UCS	K.2.1
Atkinson	Patrick		DC_M7611	UCS	K.2.1
Atkinson	William		DC_M6753	UCS	K.2.1
Ator	Silvia		DC_M6057	UCS	K.2.1
Atwell	Julie		DC_M0787	UCS	K.2.1
Atwell	Thom		DC_M1084	UCS	K.2.1
Auerbach	Joanne		DC_M5172	UCS	K.2.1
Augsburger	Catherine		DC_M7106	UCS	K.2.1
Austerman	Darla		DC_M2545	UCS	K.2.1
Austin	Neal		DC_M7415	UCS	K.2.1
Avery	Charlotte		DC_M5341	UCS	K.2.1
Avery	Rachel		DC_M1082	UCS	K.2.1
Avila	Ron		DC_M2360	UCS	K.2.1
Axelrod	Evelyne		DC_M1029	UCS	K.2.1
Axelrod	Evelyne		DC_M4990	UCS	K.2.1
Aycock	Lauren		DC_M7522	UCS	K.2.1
Ayers	Lauren		DC_E0320		K.3.2, K.3.3, K.3.10, K.3.11, K.3.13, K.4
Ayers	Lauren		DC_E0423		K.3.2, K.3.3, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Aylor	Anne		DC_M7074	UCS	K.2.1
Ayres	Barbara		DC_M4086	UCS	K.2.1
Ayres	Gene		DC_M5634	UCS	K.2.1
B	Caitlin		DC_M0625		K.2.1
B	Deanna		DC_M3496	UCS	K.2.1
B	J		DC_M3175	UCS	K.2.1
B.	Caitlin		DC_M1314	UCS	K.2.1
Baas	Kimberly		DC_M0744		K.2.1
Babcock	Maria		DC_M5344	UCS	K.2.1
Babiak	Katherine		DC_M5353	UCS	K.2.1

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Babiak	Katherine		DC_M6624	UCS	K.2.1
Babst	Christina		DC_M1056	UCS	K.2.1
Bach	Liza		DC_M6259	UCS	K.2.1
Bacher	Dan		DC_PHO0013	Central American Action Committee	K.3.1, K.3.2, K.3.3, K.3.12, K.3.13, K.4
Bacher	Daniel		DC_M1687	UCS	K.2.1
Bachman	Fritz		DC_M7664	UCS	K.2.1
Bachman	James		DC_M7290	UCS	K.2.1
Bachman	Jerald		DC_M2194	UCS	K.2.1
Bachmann	Nancy		DC_M2736	UCS	K.2.1
Back	Barbara		DC_M7735		K.2.1
Backman	Rebecca		DC_M7809		K.2.3
Bacon	Christine		DC_M0497		K.2.1
Bader	Diane		DC_M2070	UCS	K.2.1
Bader	John		DC_M5247	UCS	K.2.1
Baer	Michael		DC_M7430	UCS	K.2.1
Baert	Robin		DC_M3102	UCS	K.2.1
Bafus	Marjean		DC_M6815	UCS	K.2.1
Bagby	Tiffany		DC_M4603	UCS	K.2.1
Baggs	Bo		DC_M6035	UCS	K.2.1
Bagley	L.		DC_M4138	UCS	K.2.1
Bagley-Marray	J.		DC_M3320	UCS	K.2.1
Bagnarol	Carolina		DC_M0151		K.2.1
Bahl	Suzan		DC_M1154	UCS	K.2.1
Bailey	Arlene		DC_M4853	UCS	K.2.1
Bailey	William		DC_M4013	UCS	K.2.1
Bailey-Pruc	Susan		DC_M5909	UCS	K.2.1
Bailis	Ishara	Tim Bowler	DC_M0109		K.2.1
Baillargeon	Monique		DC_M7613	UCS	K.2.1
Baily	Walter H.		DC_M3955	UCS	K.2.1
Bain	Jordan		DC_M7103	UCS	K.2.1
Bains	Betty		DC_M1477	UCS	K.2.1
Baird	Hope		DC_M2827	UCS	K.2.1
Baird	Valerie J.		DC_M4842	UCS	K.2.1
Bakenhus	Diane		DC_M2607	UCS	K.2.1
Baker	Arlene		DC_M4562	UCS	K.2.1
Baker	Caryn		DC_M2052	UCS	K.2.1
Baker	Douglas	Debra Baker	DC_M4923	UCS	K.2.1
Baker	Jennifer		DC_M3930	UCS	K.2.1
Baker	Sheila		DC_E0206		K.3.6, K.3.11
Baker	Stacey		DC_M0855	UCS	K.2.1
Baker	Steve		DC_M4286	UCS	K.2.1
Bakker	Tom		DC_M2611	UCS	K.2.1
Balch	Justin		DC_M3073	UCS	K.2.1
Baldocchi	Jim		DC_M6578	UCS	K.2.1
Baldomar	Lindsay		DC_M4352	UCS	K.2.1
Balducci	Louise		DC_M1098	UCS	K.2.1
Baldwin	Michelle		DC_M1102	UCS	K.2.1
Baldwin	Richard	Roberta Baldwin	DC_E0200		K.2.2
Baldyga	Helena		DC_M4518	UCS	K.2.1
Ball	Jason B		DC_M2983	UCS	K.2.1
Ball	Lon		DC_E0276		K.3.3, K.3.4, K.3.5, K.3.6, K.3.7, K.3.13
Ball	Jason B.		DC_M0697		K.2.1
Ballard	Jason		DC_M5413	UCS	K.2.1
Ballard	Phyllis M		DC_M3332	UCS	K.2.1
Ballator	Nada		DC_M4985	UCS	K.2.1
Ballender	Brooks		DC_M3357	UCS	K.2.1
Ballentine	Wanda		DC_M5002	UCS	K.2.1

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Balluff	Maureen		DC_M0666		K.2.1
Balluff	Maureen		DC_M5118	UCS	K.2.1
Balsai	Michael J.		DC_M3483	UCS	K.2.1
Balter	Jim		DC_M4319	UCS	K.2.1
Baltzer	Harry		DC_M2243	UCS	K.2.1
Banashek	Christel		DC_M2106	UCS	K.2.1
Banaski	Ada		DC_M4085	UCS	K.2.1
Baney	Brett		DC_M0322		K.2.1
Bankey	Michelle		DC_M4801	UCS	K.2.1
Banoczy	Mila		DC_M6949	UCS	K.2.1
Banyai	Steve		DC_M0539		K.2.1
Baptista	D.M.		DC_M7316	UCS	K.2.1
Barankovich	Amy L		DC_M3204	UCS	K.2.1
Barbas	Tom		DC_M1231	UCS	K.2.1
Barbour	Sharon		DC_M1186	UCS	K.2.1
Bard	David		DC_M2882	UCS	K.2.1
Bardell	Timothy		DC_M1010	UCS	K.2.1
Bardsley	Alta M.		DC_M3360	UCS	K.2.1
Barella	Frank		DC_M5732	UCS	K.2.1
Barfield	Ellen	Carol Urner	DC_M0266	Women's Intenational Leauge Peace and Freedom	K.3.1, K.3.2, K.3.3, K.3.4, K.3.5, K.3.10, K.3.11, K.3.13, K.3.15, K.4
Barfield	Ellen	Carol Urner	DC_M0267	Women's Intenational Leauge Peace and Freedom	K.3.1, K.3.6, K.3.11, K.3.12, K.3.15, K.4
Barfield	Ellen	Carol Urner	DC_M0268	Women's Intenational Leauge Peace and Freedom	K.3.1, K.3.11, K.3.15, K.4
Barfield	Ellen		DC_M0425		K.2.1
Barfield	Ellen		DC_M6260	UCS	K.2.1
Bargeron	Ellen		DC_M5658	UCS	K.2.1
Barile	Dominic		DC_M1202	UCS	K.2.1
Baris	Geraldine		DC_M1089	UCS	K.2.1
Barker	Bridget		DC_M4369	UCS	K.2.1
Barker	David		DC_M0204		K.2.1
Barker	Dwinna		DC_M4478	UCS	K.2.1
Barker	Jean		DC_E0349		K.2.2
Barker	Rie		DC_M4475	UCS	K.2.1
Barnard	Michele		DC_M4840	UCS	K.2.1
Barnard	Robert		DC_M3195	UCS	K.2.1
Barnard	Sylvia		DC_M6078	UCS	K.2.1
Barnes	Alicia		DC_M0502		K.2.1
Barnes	Christopher		DC_M1552	UCS	K.2.1
Barnes	Sophie		DC_M2831	UCS	K.2.1
Barnes	Steve		DC_M0640		K.2.1
Barnes	Zimryah		DC_M2304	UCS	K.2.1
Barnes	Zimryah		DC_M2305	UCS	K.2.1
Barnes	Zimryah		DC_M2306	UCS	K.2.1
Barnett	Elizabeth		DC_M6847	UCS	K.2.1
Barnhart	Patricia		DC_M4763	UCS	K.2.1
Barnhart	Patricia		DC_M6075	UCS	K.2.1
Barnhart	Richard		DC_E0135		K.3.2, K.3.3, K.3.7, K.3.10
Barnhart	Robert J.		DC_M2828	UCS	K.2.1
Barnum	Dan		DC_M4003	UCS	K.2.1
Barondes	Lisa		DC_M1373	UCS	K.2.1

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Barone	Linda		DC_M0870	UCS	K.2.1
Barouh	David		DC_M7440	UCS	K.2.1
Barrett	Creighton		DC_E0357		K.2.2
Barrett	Delia		DC_M0409		K.2.1
Barrett	Luv Lee		DC_M4034	UCS	K.2.1
Barrios	Sandy		DC_M4201	UCS	K.2.1
Barron	Keith Reeves		DC_M7739		K.3.17
Barron	Maureen		DC_M0126		K.2.1
Barry	Bruce		DC_M4175	UCS	K.2.1
Barry	Kevin J.		DC_M4440	UCS	K.2.1
Barry	Marina		DC_M1075	UCS	K.2.1
Bartczak	Andi Weiss		DC_M2808	UCS	K.2.1
Bartell	Ann		DC_M1670	UCS	K.2.1
Bartell	Karen		DC_M4204	UCS	K.2.1
Barth	Norma		DC_M0248		K.3.2, K.3.7, K.3.11, K.3.15
Bartholome	Sandra		DC_M5370	UCS	K.2.1
Bartholomew	Alice		DC_E0312		K.3.7, K.3.14
Bartlett	Denise		DC_M6016	UCS	K.2.1
BartlettPalmer	Gwen		DC_M2993	UCS	K.2.1
Barton	Roberta		DC_M7537	UCS	K.2.1
Bartz	Sarah		DC_M1239	UCS	K.2.1
Barwig	Juliana		DC_M7656	UCS	K.2.1
Bash	Roberta		DC_M3897	UCS	K.2.1
Basinet	Cynthia		DC_M2639	UCS	K.2.1
Baskin	Martin		DC_M0801	UCS	K.2.1
Bassein	Susan		DC_E0359		K.3.7, K.3.14
Bassein	Susan		DC_M5235	UCS	K.2.1
Bassett	Anne		DC_M1032	UCS	K.2.1
Bastasch	Beth		DC_M1026	UCS	K.2.1
Bastian	Jaime		DC_M3522	UCS	K.2.1
Bastron	Malcom		DC_M3404	UCS	K.2.1
Bate	Rosalie		DC_M4041	UCS	K.2.1
Bateman	Kathy		DC_M4185	UCS	K.2.1
Bates	Chris		DC_M3875	UCS	K.2.1
Batres	Karen		DC_M2391	UCS	K.2.1
Batson	Virginia		DC_M5947	UCS	K.2.1
Batt	Kay		DC_M0900	UCS	K.2.1
Bauer	Crystal		DC_M2376	UCS	K.2.1
Bauer	Isabel		DC_M3507	UCS	K.2.1
Bauer	Michel		DC_M7819		K.2.1
Baugher	Anne Marie		DC_M2151	UCS	K.2.1
Bauman	Rae		DC_M2572	UCS	K.2.1
Baumgartner	Ellen		DC_M6413	UCS	K.2.1
Baumgartner	Kay		DC_M7390	UCS	K.2.1
Baumli	Francis		DC_E0342	Abbe Sudvarg	K.3.1, K.3.2, K.3.7, K.3.10, K.3.12, K.3.11, K.3.13
Baurer	Pattie		DC_M0372		K.2.1
Baustian	Joan		DC_M2421	UCS	K.2.1
Bava	Michelle		DC_M3545	UCS	K.2.1
Baxter	Martha		DC_M5005	UCS	K.2.1
Bayley	Ray		DC_E0442		K.3.1, K.3.2, K.3.10, K.3.14
Bayne	Kris		DC_M4151	UCS	K.2.1
Beach	Carrie		DC_M1939	UCS	K.2.1
Beach	Craig R.		DC_M1489	UCS	K.2.1
Beagan	Colleen		DC_M6987	UCS	K.2.1
Beal	Glenda		DC_M6603	UCS	K.2.1
Beam	Carolyn		DC_M6712	UCS	K.2.1
Beams	Kay		DC_M2614	UCS	K.2.1
Bean	Jerralyn		DC_M3812	UCS	K.2.1

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Bean	Heather		DC_M5764	UCS	K.2.1
Bear	Richard G.		DC_M3559	UCS	K.2.1
Bear	White		DC_M4659	UCS	K.2.1
Beardsley	Claire		DC_M5652	UCS	K.2.1
Beatini	Tom		DC_M6582	UCS	K.2.1
Beattie	Willard		DC_M4176	UCS	K.2.1
Beatty	Jamie		DC_M7399	UCS	K.2.1
Beatty	Lorne		DC_M0975	UCS	K.2.1
Beaudin	Briand		DC_M1985	UCS	K.2.1
Beaulieu	Dianne		DC_M1170	UCS	K.2.1
Beaver	Wendy		DC_M0960	UCS	K.2.1
Beavers	Nancy		DC_M4776	UCS	K.2.1
Bechard	Michele		DC_M4958	UCS	K.2.1
Bechner	Azel		DC_M0916	UCS	K.2.1
Beck	Holly		DC_M1449	UCS	K.2.1
Becker	Anna		DC_M3076	UCS	K.2.1
Becker	Clark		DC_M7766		K.2.1
Becker	Jill		DC_M5970	UCS	K.2.1
Becker	John		DC_E0258		K.2.2
Becker	Karen		DC_M4490	UCS	K.2.1
Becker	Kerstin		DC_M3376	UCS	K.2.1
Becker	Michael		DC_E0278		K.3.10, K.3.13, K.3.15
Becker	Michael		DC_M4612	UCS	K.2.1
Beckner	Azel		DC_M6671	UCS	K.2.1
Beckner	Azel Hill		DC_M3435	UCS	K.2.1
Beckwith	Blane		DC_M3324	UCS	K.2.1
Beckwith	Nan		DC_M7777		K.2.1
Bedard	Marlene		DC_M7788		K.2.1
Beebe	Russell		DC_M1855	UCS	K.2.1
Beeler	A. George		DC_M4216	UCS	K.2.1
Beels	Christian		DC_M5239	UCS	K.2.1
Beeny	Diane		DC_M7796		K.2.3
Beers	Skip		DC_M1959	UCS	K.2.1
Behrens	Charles		DC_M5153	UCS	K.2.1
Behrens	Elizabeth		DC_M6385	UCS	K.2.1
Behrens	Joanna		DC_M1478	UCS	K.2.1
Behrens	Nancy		DC_M4991	UCS	K.2.1
Behrman	Jeri		DC_M2887	UCS	K.2.1
Beitrusten	Brittany		DC_M3097	UCS	K.2.1
Belcher	Edith		DC_M6928	UCS	K.2.1
Bell	Ann		DC_M3596	UCS	K.2.1
Bell	B.J.		DC_M3445	UCS	K.2.1
Bell	Joyce		DC_M6212	UCS	K.2.1
Bell	Patricia		DC_M3598	UCS	K.2.1
Bell	Ray		DC_M1570	UCS	K.2.1
Bellamy	Winthrop Dexter		DC_M4007	UCS	K.2.1
Bellofatto	Gloria		DC_M0878	UCS	K.2.1
Bellofatto	Gloria		DC_M0879	UCS	K.2.1
Bellomy	Barbara		DC_M5864	UCS	K.2.1
Benarroch	Sue		DC_M4001	UCS	K.2.1
Bendix	Peyton		DC_M1510	UCS	K.2.1
Bendorf	Jeane K.		DC_M0471		K.2.1
Benioff	Jeanne		DC_M5690	UCS	K.2.1
Benjamin	Donna		DC_M3391	UCS	K.2.1
Benner	Dave		DC_M4019	UCS	K.2.1
Bennett	Darby		DC_M7134	UCS	K.2.1
Bennett	Henry J.		DC_M6401	UCS	K.2.1
Bennett	Jami		DC_M2704	UCS	K.2.1
Bennett	Katherine		DC_M2436	UCS	K.2.1

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Bennett	Kirbie		DC_M3616	UCS	K.2.1
Bennett	Lois		DC_M2384	UCS	K.2.1
Bennett	Micheal		DC_M2626	UCS	K.2.1
Bennett	William		DC_M6329	UCS	K.2.1
Benredjem	Alicia		DC_M2392	UCS	K.2.1
Bensinger	Irene		DC_M3056	UCS	K.2.1
Benson	Richard		DC_M2345	UCS	K.2.1
Bentley	Sean		DC_M6743	UCS	K.2.1
Bercan	A		DC_M3638	UCS	K.2.1
Berdeen	Joanne		DC_M4610	UCS	K.2.1
Beretta	Jeanne		DC_M5780	UCS	K.2.1
Berg	Elaine		DC_M5942	UCS	K.2.1
Berg	Joyce		DC_M7701		K.2.1
Berg	Kurt		DC_M1901	UCS	K.2.1
Bergamini	Miriam		DC_E0421		K.2.2
Berghofer	Richard		DC_M5397	UCS	K.2.1
Bergman	Mikey		DC_M2699	UCS	K.2.1
Bergmann	Fred		DC_M3761	UCS	K.2.1
Berke	Claire		DC_M1788	UCS	K.2.1
Berkowitz	Henry		DC_M3211	UCS	K.2.1
Berley	William		DC_M0133		K.3.14
Berlin	Susan		DC_M2224	UCS	K.2.1
Berman	Lila		DC_M1198	UCS	K.2.1
Berman	Lila	Irv Berman	DC_M1200	UCS	K.2.1
Berman	Nancy		DC_M0606		K.2.1
Berman	Nancy		DC_M0694		K.2.1
Berman	Nancy		DC_M7459	UCS	K.2.1
Bermingham	Bryce		DC_M6056	UCS	K.2.1
Bermudez	Pamela		DC_M6857	UCS	K.2.1
Bermudez	Pamela		DC_M7202	UCS	K.2.1
Bernacchi	Carol		DC_M6183	UCS	K.2.1
Bernal	Athena		DC_M2921	UCS	K.2.1
Bernard	Doris		DC_M1666	UCS	K.2.1
Bernard	Larry		DC_M6886	UCS	K.2.1
Bernardi	Sara		DC_M7574	UCS	K.2.1
Bernd-Steffes	Dawn E.		DC_M0534		K.2.1
Bernet	Maurita		DC_M4091	UCS	K.2.1
Bernet	Maurita		DC_M4092	UCS	K.2.1
Bernet	Maurita		DC_M4093	UCS	K.2.1
Bernhardt	Jill		DC_M1826	UCS	K.2.1
Bernhardt	Laura		DC_M0307		K.2.1
Bernini-Galup	Tshilo		DC_M1783	UCS	K.2.1
Bernstein	Alison		DC_M2794	UCS	K.2.1
Bernstein	James		DC_M0798	UCS	K.2.1
Bernstein	Linda		DC_M4210	UCS	K.2.1
Bernstein	Marion		DC_E0438		K.3.1, K.3.2, K.3.13, K.3.14
Bernstein	Marion		DC_M7833		K.2.1
Bernstein	Sheryl		DC_M2807	UCS	K.2.1
Bernstock	Jennifer		DC_M0378		K.2.1
Bernucca	Greg		DC_M6909	UCS	K.2.1
Berry	Robert		DC_M1563	UCS	K.2.1
Berryman	Jean		DC_M0552		K.2.1
Berti	Ron		DC_M4115	UCS	K.2.1
Berti	Ron		DC_M4883	UCS	K.2.1
Bertman	Renee		DC_M1315	UCS	K.2.1
Berube	Matthew		DC_M6482	UCS	K.2.1
Bessman	Marcelle		DC_M2984	UCS	K.2.1
Bethel	James A.		DC_M4873	UCS	K.2.1
Bethune	John		DC_M4636	UCS	K.2.1

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Betz	John		DC_M0292		K.2.1
Beugless	Virginia		DC_M5366	UCS	K.2.1
Bevan	Heather		DC_M3262	UCS	K.2.1
Bezella	Andrew		DC_M7361	UCS	K.2.1
Bhakti	Sara		DC_E0171	member UCS	K.3.14
Bhakti	Sara		DC_M6520	UCS	K.2.1
Bhakti	Sara		DC_M6521	UCS	K.2.1
Bhutani	Gundl		DC_M1998	UCS	K.2.1
Biasci	Laura		DC_M1431	UCS	K.2.1
Biava	Peter		DC_M3246	UCS	K.2.1
Bielefeld	Ruth		DC_M5972	UCS	K.2.1
Bigler	Annette		DC_M7775		K.2.1
Bilecki	Michael		DC_M1323	UCS	K.2.1
Billau	Kenneth		DC_M3317	UCS	K.2.1
Bills	Brian		DC_M4334	UCS	K.2.1
Bilowus	Helen		DC_M4719	UCS	K.2.1
Bindrim	Erica		DC_M1719	UCS	K.2.1
Birchem	Regina		DC_E0407		K.3.9
Birchem	Regina	Edel Havin Beukes	DC_E0433	Women's International League for Peace and Freedom	K.3.1, K.3.5, K.3.14, K.3.15
Bircumshaw	Kristie		DC_M2636	UCS	K.2.1
Bird	Kenneth		DC_M5547	UCS	K.2.1
Bird	Stonewall		DC_M7294	UCS	K.2.1
Birdsey	Barbara		DC_M7721		K.3.10, K.3.15
Birdwell	Tom		DC_M6597	UCS	K.2.1
Birger	Sarah		DC_E0397		K.3.1, K.3.2, K.3.3, K.3.12, K.3.15
Birnbaum	David		DC_M6574	UCS	K.2.1
Birnbaum	Shelley		DC_M1583	UCS	K.2.1
Birnie	Patricia		DC_M0234	Tucson Branch, Women's International League for Peace and Freedom	K.3.1, K.3.2, K.3.3, K.3.4, K.3.12, K.3.13, K.3.15, K.4
Bisbing	John		DC_M1524	UCS	K.2.1
Bischoff	Carol		DC_M4458	UCS	K.2.1
Bischoff	Mary		DC_M1115	UCS	K.2.1
Biscotti	Shirley		DC_M3562	UCS	K.2.1
Biser	David		DC_M4824	UCS	K.2.1
Bishop	Carolyn		DC_M7784		K.3.2, K.3.4, K.3.5, K.3.7, K.3.10, K.3.11
Bishop	Dan		DC_M2653	UCS	K.2.1
Bishop	Justin		DC_M1730	UCS	K.2.1
Bishop	Lynn		DC_M4014	UCS	K.2.1
Bishop-Henry	Karyn		DC_M2278	UCS	K.2.1
Bissonnette	Rick		DC_M4775	UCS	K.2.1
Bissonnnette	Raymond		DC_M2613	UCS	K.2.1
Biswas	Auri		DC_M5092	UCS	K.2.1
Bittler	S.		DC_M7449	UCS	K.2.1
Bittler	S.		DC_M0699		K.2.1
Bixter	Pamela		DC_M4566	UCS	K.2.1
Bixter	Pamela		DC_M6101	UCS	K.2.1
Black	Janet		DC_M6178	UCS	K.2.1
Black	Karina		DC_M3300	UCS	K.2.1
Black	Mary		DC_E0288		K.3.3, K.3.10, K.3.12
Black	Nancy		DC_M7570	UCS	K.2.1
Black	Patricia		DC_M0358		K.2.1

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Black	Patricia		DC_M5179	UCS	K.2.1
Black	Patricia		DC_M5818	UCS	K.2.1
Blackwell	Christopher		DC_M1979	UCS	K.2.1
Blackwood	Kimathi		DC_M4403	UCS	K.2.1
Blahut	Natalie H.		DC_M7218	UCS	K.2.1
Blair	Kathie L		DC_M3274	UCS	K.2.1
Blaisdell	Jill		DC_M2677	UCS	K.2.1
Blaisdell	Steven		DC_M5728	UCS	K.2.1
Blake-Collins	Brian		DC_M0686		K.2.1
Blakely	Carmen		DC_M2881	UCS	K.2.1
Blakemore	Bud		DC_M1607	UCS	K.2.1
Blanchard	Charles M.		DC_M1771	UCS	K.2.1
Blanchette	Tim		DC_M0006		K.2.2
Blanchford	Pheobe		DC_M2746	UCS	K.2.1
Blanco	Sebastian		DC_PHO0061		K.3.12
Bland	Dean	Emilia Bland	DC_M0281		K.2.1
Blankenhorn	Roland		DC_M0579		K.2.1
Blaski	Barbara		DC_M5549	UCS	K.2.1
Blaszczak	Joe		DC_M6972	UCS	K.2.1
Blau	Deborah		DC_M6912	UCS	K.2.1
Blavin	Eli		DC_M3792	UCS	K.2.1
Blecker	Catherine		DC_M7061	UCS	K.2.1
Bledsoe	Jessica		DC_M2448	UCS	K.2.1
Bleu	Joan		DC_M3491	UCS	K.2.1
Blevins	Frances		DC_M1751	UCS	K.2.1
Blickens	Donald		DC_M1872	UCS	K.2.1
Blier	Robin		DC_M0886	UCS	K.2.1
Blobel	Carl		DC_M5308	UCS	K.2.1
Block	Trent		DC_M3791	UCS	K.2.1
Blomberg	Craig		DC_E0324		K.3.1, K.3.13, K.3.15
Blomquist	Karen		DC_E0381		K.3.10, K.3.12, K.3.15
Blomquist	Karen		DC_PHO0008		K.3.11, K.3.12, K.3.15
Bloom	Cheryl		DC_M5801	UCS	K.2.1
Bloomer	Jerry		DC_E0013		K.2.2
Bloomer	Jerry		DC_E0192		K.2.2
Bloomfield	Hartley		DC_M0980	UCS	K.2.1
Blossy	Christine		DC_M3432	UCS	K.2.1
Blough	Milton F.		DC_M1104	UCS	K.2.1
Blue	Malcom J.		DC_M4040	UCS	K.2.1
Blue	Marilyn		DC_M7398	UCS	K.2.1
Bluhm	Phyllis		DC_M0005		K.3.1, K.3.2, K.3.11, K.3.13, K.3.15
Blum	Robin		DC_M2020	UCS	K.2.1
Blythe	Judy		DC_E0384	Medial Association for Prevention of War (Western Australian Branch)	K.3.2, K.3.3, K.3.4, K.3.6, K.3.7, K.3.10, K.3.11, K.3.12, K.3.15
Blythe	Mary		DC_E0336		K.3.14
Boardman	William		DC_E0182		K.3.1, K.3.2, K.3.10, K.3.12, K.3.13, K.3.14
Boast	Keith		DC_M1174	UCS	K.2.1
Bobbitt	Rachel		DC_M2803	UCS	K.2.1
Bobrick	Heather		DC_M5768	UCS	K.2.1
Bobroff	Alex A.		DC_M5662	UCS	K.2.1
Bodah	Brian		DC_M0031		K.2.1
Bodah	Brian		DC_M4126	UCS	K.2.1
Bodden	Joshua B.		DC_M1936	UCS	K.2.1

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Bodeau	Jean		DC_PHO0037		K.3.1, K.3.2, K.3.3, K.3.4, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Bodemar	Jeri		DC_M6963	UCS	K.2.1
Bodmer	Paul		DC_M2749	UCS	K.2.1
Bodry	Theolet		DC_M6976	UCS	K.2.1
Boeck	Lara		DC_M5144	UCS	K.2.1
Boehm	Marjorie		DC_PHO0020	Women's International League for Peace and Freedom, United States Section	K.3.2, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15
Boelling	Gary		DC_M4759	UCS	K.2.1
Boes	Gregory		DC_M5040	UCS	K.2.1
Bogart	Brian		DC_M5555	UCS	K.2.1
Bogert	Tracy		DC_M2417	UCS	K.2.1
Bogiani	Bernard		DC_M2795	UCS	K.2.1
Bohn	David		DC_M0071		K.2.1
Bois	Bill		DC_M4682	UCS	K.2.1
Boisselle	Marie-France		DC_M0091		K.2.1
Boitano	Connie		DC_M1941	UCS	K.2.1
Boivin	Jacque		DC_M1219	UCS	K.2.1
Bojo	Jan		DC_M4120	UCS	K.2.1
Boka	Madeleine		DC_M5175	UCS	K.2.1
Boka	Madeleine		DC_M5176	UCS	K.2.1
Boldenow	Kevin		DC_M3981	UCS	K.2.1
Bolema	Tom		DC_E0226		K.3.1, K.3.3, K.3.4, K.3.5
Bolia	Donna		DC_M4028	UCS	K.2.1
Bolin	Amy		DC_M0710		K.2.1
Bolin	Amy		DC_M0789	UCS	K.2.1
Boller	Robert		DC_M3481	UCS	K.2.1
Bologna	Maria		DC_M5870	UCS	K.2.1
Bommer	Betsy		DC_M5484	UCS	K.2.1
Bonasera	Michael		DC_M0434		K.2.1
Bonaventure	Debbie		DC_M4450	UCS	K.2.1
Bond	Julie		DC_M5398	UCS	K.2.1
Bond	RD		DC_M1407	UCS	K.2.1
Boneck	Tamara		DC_M0357		K.2.1
Boniske	Nathan		DC_M2787	UCS	K.2.1
Bonk	Marliese		DC_M0946	UCS	K.2.1
Bonner	Francis		DC_M7128	UCS	K.2.1
Bonner	V. John		DC_M0680		K.2.1
Bonner	V. John		DC_M4816	UCS	K.2.1
Bonomo	Dan		DC_M6471	UCS	K.2.1
Bookidis	Paul		DC_M1481	UCS	K.2.1
Books	Jennifer		DC_M5258	UCS	K.2.1
Boone	Rodney		DC_M5713	UCS	K.2.1
Boorn	T		DC_M5038	UCS	K.2.1
Booth	Elaine		DC_M4624	UCS	K.2.1
Booth	James		DC_M3434	UCS	K.2.1
Borden	Gina Maslow		DC_M6918	UCS	K.2.1
Bordenave	M		DC_M4761	UCS	K.2.1
Borelli	Elizabeth		DC_M4914	UCS	K.2.1
Borg	Donald		DC_M3971	UCS	K.2.1
Borgo	Rob		DC_M6262	UCS	K.2.1
Born	Meredith		DC_M6547	UCS	K.2.1
Bornemann	Michael		DC_M1994	UCS	K.2.1
Borovski	Conrad		DC_M1052	UCS	K.2.1
Borrowman	Ellen		DC_M5731	UCS	K.2.1

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Borske	Cindy		DC_M0228		K.2.1
Bortner	Jim		DC_M1408	UCS	K.2.1
Boruck	Holly		DC_M5684	UCS	K.2.1
Borum	E		DC_M7610	UCS	K.2.1
Bosbach	Crystal		DC_M6403	UCS	K.2.1
Bosch	Ronald		DC_E0011		K.3.11, K.3.12, K.3.13
Boschert	Carol		DC_E0287		K.2.2
Bosco	Joanne		DC_M7466	UCS	K.2.1
Bostic	Marie		DC_E0218		K.2.2
Boswell	Julie		DC_M6813	UCS	K.2.1
Botani	BZ		DC_M6392	UCS	K.2.1
Bote	Maryl		DC_M2457	UCS	K.2.1
Bott	Terry		DC_M4389	UCS	K.2.1
Bottesch	Marnie		DC_M2755	UCS	K.2.1
Bottner	Rob		DC_M7658	UCS	K.2.1
Botto	Tancredi		DC_M7513	UCS	K.2.1
Bottomly	Lewis		DC_M6610	UCS	K.2.1
Botwinick	Joan		DC_M0042		K.3.1, K.3.2, K.3.3, K.3.6, K.3.7, K.3.10, K.3.13, K.3.15
Bouajila	Christina		DC_M6058	UCS	K.2.1
Boucher	Fred		DC_M4430	UCS	K.2.1
Boucher	Micheal		DC_M2937	UCS	K.2.1
Boudin	Rachel		DC_M0760		K.2.1
Boughan	Tom		DC_M3895	UCS	K.2.1
Boule	Michael		DC_M5296	UCS	K.2.1
Bourne	Marcia		DC_M4018	UCS	K.2.1
Bowen	Neal		DC_M0485		K.2.1
Bowers	James		DC_M1822	UCS	K.2.1
Bowers-Janowicz	Seneca		DC_M6982	UCS	K.2.1
Bowling-Schaff	Kristin		DC_M7907		K.2.1
Bowlus	Mark		DC_M2729	UCS	K.2.1
Bowman	Katherine		DC_M7648	UCS	K.2.1
Bowman	Kenneth		DC_M1113	UCS	K.2.1
Bowman	Margaret M.		DC_M0932	UCS	K.2.1
Bowman	Nan Singh		DC_M4843	UCS	K.2.1
Boyce	Eric		DC_M2247	UCS	K.2.1
Boyd	Christin		DC_M5064	UCS	K.2.1
Boyd	Kathleen		DC_M7741		K.2.1
Boye	Barbara		DC_M3209	UCS	K.2.1
Boyle	Mary		DC_M3018	UCS	K.2.1
Boyle	Mary		DC_M4279	UCS	K.2.1
Boyle	Roxanne		DC_M5187	UCS	K.2.1
Boyle	Tamara		DC_M5082	UCS	K.2.1
Boyles	Glenn		DC_M5853	UCS	K.2.1
Boyne	Hal		DC_M1117	UCS	K.2.1
Boynton	Lisa		DC_M1697	UCS	K.2.1
Bracamonte	Sam		DC_M7217	UCS	K.2.1
Brace	Conor		DC_M2091	UCS	K.2.1
Bradburn	Steve	Sarah Bradburn	DC_M6504	UCS	K.2.1
Bradley	Kit		DC_M1953	UCS	K.2.1
Bradley	Priscilla		DC_M7085	UCS	K.2.1
Bradshaw	Mary		DC_M3772	UCS	K.2.1
Bradus	Richard		DC_M5379	UCS	K.2.1
Brady	Clare		DC_M5004	UCS	K.2.1
Brady	Matthew		DC_M2264	UCS	K.2.1
Brady	Matthew		DC_M2593	UCS	K.2.1
Brady	Sarah		DC_M1071	UCS	K.2.1
Bragga	Elisa		DC_M3343	UCS	K.2.1
Bragonier	Emily		DC_M5676	UCS	K.2.1

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Brainard II	Edward		DC_M2212	UCS	K.2.1
Brainerd	Lee		DC_M5603	UCS	K.2.1
Bralek	Rebecca		DC_M2429	UCS	K.2.1
Bramscher	Paul		DC_M3813	UCS	K.2.1
Branagan	Laura		DC_M0352		K.2.1
Branch	Katey		DC_E0042		K.2.2
Branch	Steven		DC_M0512		K.2.1
Brandariz	Anita		DC_M0679		K.2.1
Brandhorst	Kurt		DC_M2946	UCS	K.2.1
Brandt	Bruce		DC_M1099	UCS	K.2.1
Brandt	Jerri		DC_M6967	UCS	K.2.1
Brandy	Rebecca		DC_M3752	UCS	K.2.1
Brandy	Thomas		DC_M4281	UCS	K.2.1
Branham	Barbara		DC_M1873	UCS	K.2.1
Branham	Julia		DC_M3972	UCS	K.2.1
Brantlinger	Patrick		DC_M5074	UCS	K.2.1
Brantmeier	Tom		DC_M1529	UCS	K.2.1
Brasaemle	Joan		DC_M1869	UCS	K.2.1
Braverman	Michael		DC_M1536	UCS	K.2.1
Bray	Patricia		DC_M5619	UCS	K.2.1
Brazis	Chris		DC_M7349	UCS	K.2.1
Brecher	Aviva		DC_M2000	UCS	K.2.1
Breen	Salley		DC_E0196		K.2.2
Breen	Sally		DC_E0016		K.3.3, K.3.6, K.3.7, K.3.11, K.3.12, K.3.15
Breeze	Jeannie		DC_M6363	UCS	K.2.1
Breeze	Tim		DC_M0802	UCS	K.2.1
Brehm	Kristy		DC_M1245	UCS	K.2.1
Breiby	Wendy		DC_M5361	UCS	K.2.1
Breitbart	Todd		DC_M4063	UCS	K.2.1
Bremer	Naomi		DC_M7469	UCS	K.2.1
Bremner	Steven		DC_M6533	UCS	K.2.1
Brennan	Holley		DC_M0461		K.2.1
Brennan	Mary		DC_M5466	UCS	K.2.1
Brennan	Sherman		DC_M3774	UCS	K.2.1
Brenneisen	Scott		DC_M6735	UCS	K.2.1
Brenner	Deborah		DC_M6998	UCS	K.2.1
Brenner	Esther		DC_M7063	UCS	K.2.1
Brenner	Lisa		DC_M5999	UCS	K.2.1
Brenner	Natasha	Noah Brenner	DC_M7473	UCS	K.2.1
Brennis	Robert		DC_M5339	UCS	K.2.1
Brentjens	Vero		DC_M6599	UCS	K.2.1
Brenton	Petricia		DC_M5382	UCS	K.2.1
Breslin-Romano	Danielle		DC_E0028		K.3.9
Breuninger	Maria		DC_M1016	UCS	K.2.1
Breuninger	Maria		DC_M6703	UCS	K.2.1
Brewer	Alex		DC_M0621		K.2.1
Brewer	Jeannine		DC_M4977	UCS	K.2.1
Brewster	Emily		DC_M5000	UCS	K.2.1
Brewwer	George		DC_M7925		K.3.2, K.3.7, K.3.10, K.3.13, K.3.15
Brickell	Arthur		DC_M0338		K.2.1
Brill	Scott		DC_M3721	UCS	K.2.1
Brillon	Maurice		DC_M4921	UCS	K.2.1
Brindel	Carrie		DC_M7419	UCS	K.2.1
Briney	Michael		DC_M7948		K.3.1, K.3.2, K.3.3, K.3.4, K.3.5, K.3.7, K.3.10, K.3.11, K.3.13, K.3.14, K.3.15
Brinkmeyer	Linda		DC_M7719		K.2.1

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Brissette	Peggy		DC_M2822	UCS	K.2.1
Britfeld	K		DC_M2271	UCS	K.2.1
Brito	Ana		DC_M0678		K.2.1
Brito	Ana		DC_M2491	UCS	K.2.1
Brittain	Susan		DC_M3084	UCS	K.2.1
Britton	Joanne		DC_M1267	UCS	K.2.1
Britton	William		DC_M4745	UCS	K.2.1
Broadbent	Catherine		DC_M1807	UCS	K.2.1
Broadbent	Jerry		DC_M2497	UCS	K.2.1
Broberg	Paul		DC_M0072		K.2.1
Brock	Suzanne		DC_M5431	UCS	K.2.1
Brockway	Christi Michelle		DC_M0825	UCS	K.2.1
Brodbar	Barbara		DC_M0012		K.3.3, K.3.7, K.3.13
Broderick	Alfa		DC_M6246	UCS	K.2.1
Brofman	Peter		DC_M6378	UCS	K.2.1
Brogan	Loretta		DC_M7167	UCS	K.2.1
Bromer	John		DC_M6044	UCS	K.2.1
Bronk	James		DC_M4626	UCS	K.2.1
Brooker	Mark		DC_M6598	UCS	K.2.1
Brookes	S.C.		DC_M3717	UCS	K.2.1
Brookner	Jacalyn		DC_M2862	UCS	K.2.1
Brooks	Allen		DC_M7515	UCS	K.2.1
Brooks	Frank		DC_M5994	UCS	K.2.1
Brooks	Jo M		DC_M1149	UCS	K.2.1
Brooks	Sky		DC_M6308	UCS	K.2.1
Brooks			DC_M7304	UCS	K.2.1
Brosen	Alexis		DC_M2811	UCS	K.2.1
Brostrom	Elaine		DC_M6059	UCS	K.2.1
Brotherton	Anne		DC_E0233		K.3.1, K.4
Brown	Ann		DC_M5019	UCS	K.2.1
Brown	Bob		DC_M0110		K.2.1
Brown	Bonnie		DC_M0632		K.2.1
Brown	Bonnie		DC_M1756	UCS	K.2.1
Brown	Carol		DC_M0177		K.3.14
Brown	Diane		DC_M0719		K.2.1
Brown	Diane		DC_M7718		K.2.1
Brown	Elizabeth		DC_M0048		K.2.2
Brown	Ken		DC_M2591	UCS	K.2.1
Brown	Ken		DC_M7394	UCS	K.2.1
Brown	Kevin		DC_M4191	UCS	K.2.1
Brown	Kevin		DC_M6071	UCS	K.2.1
Brown	Kimberly		DC_M7938		K.3.2, K.3.3
Brown	Leila		DC_E0420		K.2.2
Brown	Linda K.		DC_M3924	UCS	K.2.1
Brown	Linda M.		DC_M1569	UCS	K.2.1
Brown	Mary	Ed Rutherford	DC_M0500		K.2.1
Brown	Myrna		DC_M5302	UCS	K.2.1
Brown	Patria		DC_M6865	UCS	K.2.1
Brown	Renate		DC_M2231	UCS	K.2.1
Brown	Ronald		DC_M3540	UCS	K.2.1
Brown	Ronald E.		DC_M1937	UCS	K.2.1
Brown	Sandra		DC_M1784	UCS	K.2.1
Brown	Sharon		DC_M7810		K.2.1
Brown	Timothy		DC_M6219	UCS	K.2.1
Brown	Wendy		DC_M1741	UCS	K.2.1
Brown	Wendy		DC_M7899		K.2.3
Brown	Wolstan		DC_M2098	UCS	K.2.1
Brown	Niyati		DC_M4532	UCS	K.2.1
Brown	V.K.		DC_M4950	UCS	K.2.1

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Browne	RJ		DC_M2064	UCS	K.2.1
Browning	Mary		DC_M6139	UCS	K.2.1
Brownlee	Victoria		DC_M5736	UCS	K.2.1
Brown-Nolan	Virginia		DC_M0449		K.2.1
Brown-Nolan	Virginia		DC_M7235	UCS	K.2.1
Brown-Roth	Georgean		DC_M4432	UCS	K.2.1
Brownscombe	Robert		DC_M3526	UCS	K.2.1
Brownstein	Shale		DC_M4860	UCS	K.2.1
Bruce	Leslie		DC_M3508	UCS	K.2.1
Bruce-Munro	Jane		DC_M4239	UCS	K.2.1
Bruell	Marc J		DC_M0702		K.2.1
Bruml	Bill		DC_M7848		K.2.3
Brumm	Margaret		DC_M2255	UCS	K.2.1
Brumson	April		DC_M4506	UCS	K.2.1
Bruner	David		DC_M1966	UCS	K.2.1
Bruner	Scott M.		DC_M4471	UCS	K.2.1
Bruno	David		DC_M1180	UCS	K.2.1
Brunson	Dr. Kathryn		DC_M1709	UCS	K.2.1
Brussel	Morton		DC_E0092	Professor emeritus of physics, UIUC	K.3.1, K.3.2, K.3.4, K.3.10, K.3.13, K.3.14
Brust	Amy		DC_M1971	UCS	K.2.1
Bruton	Harry		DC_M6588	UCS	K.2.1
Brutscher	David		DC_M3676	UCS	K.2.1
Bryan	Melissa		DC_M1062	UCS	K.2.1
Bryant	Anne		DC_M0737		K.2.1
Bryant	Ben		DC_M4130	UCS	K.2.1
Bryant	Billy	Loretta Bryant	DC_M6887	UCS	K.2.1
Bryant	Jay		DC_M3079	UCS	K.2.1
Bryant	Lori		DC_M5273	UCS	K.2.1
Bryant	Lori		DC_M5439	UCS	K.2.1
Bryce	Carol		DC_M7407	UCS	K.2.1
Brzeczek	Amy		DC_M2227	UCS	K.2.1
Bubala	Lou		DC_M1253	UCS	K.2.1
Bubsey	Julian		DC_M3623	UCS	K.2.1
Bucci	Doreen		DC_M5168	UCS	K.2.1
Buch	Sandra		DC_M7215	UCS	K.2.1
Buchan	Kara		DC_M1413	UCS	K.2.1
Buchen	Tony		DC_M2519	UCS	K.2.1
Buchholz	Myron		DC_M3757	UCS	K.2.1
Bucki	John		DC_M4381	UCS	K.2.1
Bucki	John		DC_M5221	UCS	K.2.1
Buckles	Ron		DC_M5107	UCS	K.2.1
Buckley	Barbara		DC_M1737	UCS	K.2.1
Buckley	Laura		DC_M6311	UCS	K.2.1
Buckner	Janice		DC_M2884	UCS	K.2.1
Buckner	Robert		DC_M1346	UCS	K.2.1
Buddenbaum	Bethann		DC_M4110	UCS	K.2.1
Budding	Kelley		DC_M5216	UCS	K.2.1
Buechler	Paul		DC_M2635	UCS	K.2.1
Bugay	John		DC_M6761	UCS	K.2.1
Bugliarelli	Diane		DC_M7372	UCS	K.2.1
Buhr	Gene	Kathleen Ferrerborn, Cindy David, Freline Morelez, Belen Stanley	DC_M0272	St. Joseph Church	K.2.1
Buikema	Janine		DC_M1948	UCS	K.2.1
Bukoski	Stacy		DC_M0894	UCS	K.2.1
Bullock	Erin		DC_M6119	UCS	K.2.1
Bulter	Nora		DC_M6914	UCS	K.2.1
Bunch	Christopher		DC_M2734	UCS	K.2.1

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Bunch	Terry		DC_M6040	UCS	K.2.1
Bunkin	Scott		DC_M6945	UCS	K.2.1
Burch	Candace		DC_M7679	UCS	K.2.1
Burch	Julia		DC_M7295	UCS	K.2.1
Burde	James		DC_M0586		K.2.1
Burdge	Nancy		DC_M4397	UCS	K.2.1
Burge	Margaret Rose		DC_M0901	UCS	K.2.1
Burgess	Bonnie		DC_M3207	UCS	K.2.1
Burgess	Christine		DC_E0067		K.2.2
Burgett	Jessica		DC_M2031	UCS	K.2.1
Burke	Bonnie		DC_M7000	UCS	K.2.1
Burke	Dan		DC_M4368	UCS	K.2.1
Burke	Mark		DC_M0481		K.2.1
Burke	P.A.		DC_M6755	UCS	K.2.1
Burke	William		DC_M3168	UCS	K.2.1
Burkhart	David		DC_M4733	UCS	K.2.1
Burks	Bill		DC_M5643	UCS	K.2.1
Burks	Paul		DC_M2077	UCS	K.2.1
Burks	Paul		DC_M4394	UCS	K.2.1
Burks	Susan		DC_M2104	UCS	K.2.1
Burman	Karen		DC_M6508	UCS	K.2.1
Burnet	Marie		DC_M4740	UCS	K.2.1
Burnett	Barbara N.		DC_M3966	UCS	K.2.1
Burnett	Caryl F.		DC_M4374	UCS	K.2.1
Burnett	Joel		DC_M1461	UCS	K.2.1
Burnett	Lynda		DC_M6180	UCS	K.2.1
Burnianek	Linda		DC_M7835		K.2.1
Burns	Bridgit		DC_M7124	UCS	K.2.1
Burns	Catherine		DC_M7039	UCS	K.2.1
Burns	D		DC_M5625	UCS	K.2.1
Burns	Dana		DC_M2262	UCS	K.2.1
Burns	John		DC_M1305	UCS	K.2.1
Burns	R. Micheal		DC_M2218	UCS	K.2.1
Burns	Rikhael		DC_M5556	UCS	K.2.1
Burnside	Ellen		DC_M4149	UCS	K.2.1
Burnside	Sylvia		DC_M4848	UCS	K.2.1
Burr	Lucinda		DC_M4357	UCS	K.2.1
Burris	Judy		DC_M5529	UCS	K.2.1
Burroughs	Rain		DC_M7098	UCS	K.2.1
Burrow	Jack		DC_M0145		K.2.1
Burrow	Jack Robert		DC_M0125		K.2.1
Burrow	Kim		DC_M5442	UCS	K.2.1
Burrows	Robert		DC_M3776	UCS	K.2.1
Burton	Linda		DC_M5515	UCS	K.2.1
Busan	DB		DC_M7455	UCS	K.2.1
Busch	David		DC_M1580	UCS	K.2.1
Busch	Nancy		DC_M4708	UCS	K.2.1
Buselmeier	Robert		DC_M3074	UCS	K.2.1
Bushnell	Martha		DC_M6891	UCS	K.2.1
Businger	J.A.		DC_M0961	UCS	K.2.1
Butch	Lisa		DC_M1956	UCS	K.2.1
Butcher	Audrey		DC_M5167	UCS	K.2.1
Butler	Clay		DC_M5417	UCS	K.2.1
Butler	Doug		DC_M2380	UCS	K.2.1
Butler	John		DC_M0491		K.2.1
Butler	John		DC_M3626	UCS	K.2.1
Butler	John		DC_M4277	UCS	K.2.1
Butler	Ron		DC_M5675	UCS	K.2.1
Butler	Thomas		DC_M7086	UCS	K.2.1

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Buttel	Helen	Robert Buttel	DC_M6081	UCS	K.2.1
Butterfield	Lisa		DC_M5604	UCS	K.2.1
Butterworth	Chaula		DC_M4139	UCS	K.2.1
Buttner	Charlene		DC_M2347	UCS	K.2.1
Buttrey	L.		DC_M7338	UCS	K.2.1
Butts	Debbie		DC_M5986	UCS	K.2.1
Butz	Nathan		DC_M5846	UCS	K.2.1
Buzil	Devorah		DC_M4056	UCS	K.2.1
Buzz	M.		DC_M1629	UCS	K.2.1
Byington	Tammie		DC_M5627	UCS	K.2.1
Byrd	Barbara		DC_M2060	UCS	K.2.1
Byrdkatz			DC_M5049	UCS	K.2.1
Byrne	Margo		DC_M6655	UCS	K.2.1
Byrum	Patrick		DC_M3502	UCS	K.2.1
C.	E.		DC_M6748	UCS	K.2.1
Cabrera	John		DC_M2011	UCS	K.2.1
Cabrera	Magdalena		DC_M4937	UCS	K.2.1
Cadieux	Gregory		DC_M2859	UCS	K.2.1
Cadora	Eric		DC_M2343	UCS	K.2.1
Cady	Beth		DC_M3600	UCS	K.2.1
Caffrey	Frank		DC_M3762	UCS	K.2.1
Cagney	Tim		DC_M2915	UCS	K.2.1
Cahn	Alma		DC_M3467	UCS	K.2.1
Cahoon	Ruth		DC_M3880	UCS	K.2.1
Cain	Art		DC_M3371	UCS	K.2.1
Calabria	Antonio		DC_M0629		K.2.1
Calabria	Antonio		DC_M4089	UCS	K.2.1
Calabria	Antonio		DC_M4096	UCS	K.2.1
Calderon	Sheila		DC_M7514	UCS	K.2.1
Caldwell	Kathryn		DC_M4556	UCS	K.2.1
Caldwell	Mary Ellen		DC_E0302		K.2.2
Calhoum	Mary Laura		DC_M7479	UCS	K.2.1
Cali	Lee		DC_M6176	UCS	K.2.1
Calkins	Allegra		DC_M6432	UCS	K.2.1
Callaway	Mary		DC_M6104	UCS	K.2.1
Callazo	Jamie		DC_M3691	UCS	K.2.1
Callbeck	Helen		DC_M5763	UCS	K.2.1
Calos	Matt		DC_M3965	UCS	K.2.1
Calswell	Ellen		DC_M2888	UCS	K.2.1
Calvillo	Lucy		DC_M3755	UCS	K.2.1
Camenzind	Carl		DC_M0707		K.2.1
Camhi	Lynn		DC_M5067	UCS	K.2.1
Camillieri	Cynthia		DC_M0793	UCS	K.2.1
Camp	Brian		DC_M7314	UCS	K.2.1
Campbell	Carol		DC_M1318	UCS	K.2.1
Campbell	Cindy		DC_M6591	UCS	K.2.1
Campbell	Connie		DC_M1659	UCS	K.2.1
Campbell	D.J		DC_M0293		K.3.1, K.3.7
Campbell	Deborah		DC_M1777	UCS	K.2.1
Campbell	Deborah		DC_M2608	UCS	K.2.1
Campbell	James		DC_M2776	UCS	K.2.1
Campbell	Julie A.		DC_M1799	UCS	K.2.1
Campbell	Louis		DC_M0161	Union of Concerned Scientists	K.3.1, K.3.2, K.3.10, K.3.12, K.3.13, K.3.14, K.4
Campbell	Patricia		DC_M5388	UCS	K.2.1
Campbell	Richard		DC_M2062	UCS	K.2.1
Campbell	Scott		DC_E0040		K.3.2, K.3.4, K.3.7, K.3.12, K.3.15
Campbell	Therese		DC_M4999	UCS	K.2.1

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Canady	Larkellen		DC_M7269	UCS	K.2.1
Cannata	Amy		DC_M3270	UCS	K.2.1
Cannella	Joe		DC_M2805	UCS	K.2.1
Cannon	Frank		DC_M5765	UCS	K.2.1
Cannon	Peggy		DC_M2781	UCS	K.2.1
Cape	John		DC_M4399	UCS	K.2.1
Capece	Paula		DC_M6519	UCS	K.2.1
Capers	Robert		DC_M3519	UCS	K.2.1
Capezzuto	Valerie		DC_M2533	UCS	K.2.1
Capozzelli	J.		DC_M0033		K.2.1
Capozzelli	J.		DC_M0788	UCS	K.2.1
Capozzelli	J.		DC_M3494	UCS	K.2.1
Capozzelli	Rose		DC_M1432	UCS	K.2.1
Cappelletti	Nancy		DC_M2240	UCS	K.2.1
Caputo	Scott		DC_M3051	UCS	K.2.1
Carabine	John		DC_M7289	UCS	K.2.1
Cardell	Mona		DC_M6461	UCS	K.2.1
Carden	Helga		DC_M1006	UCS	K.2.1
Cardinal	Enid		DC_M2475	UCS	K.2.1
Cardwell	Zachariah		DC_M1878	UCS	K.2.1
Carey	John	Cathy O'Leary	DC_M0261		K.3.14
Cariou	Raphael		DC_M6279	UCS	K.2.1
Carl	Philip		DC_M0685		K.2.1
Carleton	Clovis		DC_M5860	UCS	K.2.1
Carlino	Doris		DC_M4466	UCS	K.2.1
Carlisle	Marilyn		DC_M0082		K.2.1
Carlson	Benjamin		DC_M2507	UCS	K.2.1
Carlson	Cathleen		DC_M0728		K.2.1
Carlson	Cathleen A.		DC_M4180	UCS	K.2.1
Carlson	Karin J.		DC_M0199		K.2.1
Carmack	Darryl		DC_M4947	UCS	K.2.1
Carman	Margery		DC_M1194	UCS	K.2.1
Carneal	Pat		DC_M5265	UCS	K.2.1
Carnicom	Lisa		DC_M1974	UCS	K.2.1
Carol	Yost		DC_M1011	UCS	K.2.1
Carpenter	Ann		DC_M0083		K.2.1
Carpenter	Linda		DC_M7080	UCS	K.2.1
Carpenter	Maxine		DC_E0220		K.3.10, K.3.11, K.3.12
Carpenter	Phillip		DC_M0941	UCS	K.2.1
Carpenter	Wayne L		DC_M3221	UCS	K.2.1
Carr	Barbara		DC_M1890	UCS	K.2.1
Carr	David		DC_M6594	UCS	K.2.1
Carr	Gaile		DC_M0911	UCS	K.2.1
Carr	James V		DC_M2719	UCS	K.2.1
Carr	Laurie		DC_M6602	UCS	K.2.1
Carr	Sherry		DC_M5990	UCS	K.2.1
Carrello	Julio		DC_M0880	UCS	K.2.1
Carroll	Brad		DC_M7706		K.2.1
Carroll	David		DC_M6716	UCS	K.2.1
Carroll	Glen L.		DC_M4964	UCS	K.2.1
Carroll	Mike		DC_M3093	UCS	K.2.1
Carrow	Steve		DC_M7926		K.3.7, K.3.10, K.3.13, K.3.15
Carrubba	Sandra J.		DC_M0457		K.2.1
Carsten	Barbara		DC_M2760	UCS	K.2.1
Carter	Amanda		DC_M3839	UCS	K.2.1
Carter	Cindy		DC_M4614	UCS	K.2.1
Carter	Frances		DC_M5665	UCS	K.2.1
Carter	Jenny	Francis X. Finigan	DC_E0208		K.3.3, K.3.11, K.3.15
Carter	Joni		DC_M6459	UCS	K.2.1

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Carter	Judith		DC_M7168	UCS	K.2.1
Carter	Julie B.		DC_M7329	UCS	K.2.1
Carter	Margaret		DC_M0152		K.3.14
Carter	Rand		DC_M1705	UCS	K.2.1
Cartney	Larry		DC_M4989	UCS	K.2.1
Cartwright	Barbara		DC_M0274		K.3.2, K.3.3, K.3.12, K.4
Caruso	Stephen & Connie		DC_M3306	UCS	K.2.1
Carvell	Tracy		DC_M4254	UCS	K.2.1
Carver	Alexandra		DC_M4289	UCS	K.2.1
Carver	Calvin		DC_M1358	UCS	K.2.1
Casanova	Ursula		DC_M4382	UCS	K.2.1
Casey	Echo		DC_M2521	UCS	K.2.1
Casey	Julia		DC_M7838		K.2.1
Cashner	Frances		DC_M5025	UCS	K.2.1
Caso	Mark		DC_M1372	UCS	K.2.1
Cason	Cynthia		DC_M5659	UCS	K.2.1
Cason	Sherol		DC_M6129	UCS	K.2.1
Casper	Christine		DC_M2731	UCS	K.2.1
Cassidey	Lewis		DC_M2040	UCS	K.2.1
Cassidy	Doris		DC_M6633	UCS	K.2.1
Cassini	Carol		DC_M0327		K.2.1
Cassity	Janet		DC_M3853	UCS	K.2.1
Castillo	Andrew		DC_M3035	UCS	K.2.1
Castle	Elenor		DC_M5262	UCS	K.2.1
Castor	Rachel		DC_M0217		K.2.1
Cathcart	Mary		DC_M4026	UCS	K.2.1
Caton	Barney		DC_M1750	UCS	K.2.1
Catrambone	Natalie		DC_M3934	UCS	K.2.1
Caturegli	Kathryn		DC_M2435	UCS	K.2.1
Caulfield	Sunshine A		DC_M7052	UCS	K.2.1
Caulum	Bob		DC_M2007	UCS	K.2.1
Cavallero	Dana		DC_M7021	UCS	K.2.1
Cavanaugh	Peggy		DC_M2443	UCS	K.2.1
Cave	Brendan		DC_M4943	UCS	K.2.1
Caverhill	Brennan		DC_E0177		K.2.2
Caves	Mary g.		DC_M1707	UCS	K.2.1
Cegielski	Peter		DC_M3363	UCS	K.2.1
Cerello	Robert		DC_M7917		K.2.3
Cerkoney	Jim		DC_M5689	UCS	K.2.1
Cerkowski	Michael		DC_M4768	UCS	K.2.1
Cernohlavek	Leemer G.		DC_M1161	UCS	K.2.1
Cerruti	Kathleen		DC_M5224	UCS	K.2.1
Cerullo	Nancy		DC_M6181	UCS	K.2.1
Cervin	Nichole		DC_M0996	UCS	K.2.1
Cessaro	J Paul		DC_M7420	UCS	K.2.1
Cevasco	John		DC_M3461	UCS	K.2.1
Chadbourne	Jill		DC_M4928	UCS	K.2.1
Chaifetz	Jill		DC_M6915	UCS	K.2.1
Chamberlynn	Alexia		DC_M1401	UCS	K.2.1
Chambers	Angy		DC_O0002	Environmental Impact Analysis Process (EIAP) Working Group (45 CES/CEV)	K.4
Chambers	J		DC_M2214	UCS	K.2.1
Chambers	Kate		DC_M2516	UCS	K.2.1
Chambers	Nathaniel		DC_M4479	UCS	K.2.1
Champagne	Donald		DC_M2014	UCS	K.2.1

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Champagne	Jenette		DC_M1155	UCS	K.2.1
Champion	Willie L.		DC_M7880		K.2.1
Champlin	Kit		DC_M0438		K.2.1
Chan	Sonja	Wallace Chan	DC_M5520	UCS	K.2.1
Chandler	Philip		DC_M7492	UCS	K.2.1
Chaney	Trish		DC_M4123	UCS	K.2.1
Chang	John		DC_M1277	UCS	K.2.1
Chantaramungkorn	Orakarn		DC_M6861	UCS	K.2.1
Chapanis	Roger		DC_M4142	UCS	K.2.1
Chapin	Kristi		DC_M4437	UCS	K.2.1
Chapli	Christine		DC_M6047	UCS	K.2.1
Chapman	Douglas		DC_M3160	UCS	K.2.1
Chapman	Mary		DC_M6844	UCS	K.2.1
Chapman	Robert		DC_M6620	UCS	K.2.1
Chappell	David W.		DC_M7633	UCS	K.2.1
Chappell	Donna		DC_M7196	UCS	K.2.1
Chapunoff	Alex		DC_M7894		K.2.3
Charters	Gilly		DC_E0080		K.3.4, K.3.7, K.3.11
Chary	Kaatz		DC_M6015	UCS	K.2.1
Chase	Martha		DC_M6996	UCS	K.2.1
Chase	Michael		DC_M1829	UCS	K.2.1
Chase	Tim		DC_M7040	UCS	K.2.1
Chatman	Faye		DC_M0763		K.2.1
Chattopadhyay	Rita		DC_M2555	UCS	K.2.1
Chavez-Rock	Barbara		DC_M3244	UCS	K.2.1
Chavoya	Florence		DC_M4725	UCS	K.2.1
Chay	Elysse		DC_M7055	UCS	K.2.1
Chen	Cliff		DC_M7573	UCS	K.2.1
Cheng	Mary		DC_E0243		K.2.2
Cherin	Marise		DC_M7226	UCS	K.2.1
Chernushin	Mary		DC_M6124	UCS	K.2.1
Chesebro	Michelle		DC_M5237	UCS	K.2.1
Chesek	Frank		DC_M0174		K.2.1
Chess	Deborah		DC_M5231	UCS	K.2.1
Chess	Katherine		DC_M4542	UCS	K.2.1
Cheyne	Jennifer		DC_M1525	UCS	K.2.1
Chianese	George		DC_M5911	UCS	K.2.1
Chibucos	Marcus		DC_M3236	UCS	K.2.1
Chifari	Jerry		DC_M0435		K.2.1
Child	Marilyn		DC_M7355	UCS	K.2.1
Childers	Barry		DC_E0085		K.3.2, K.3.3
Childress	Janet		DC_M4711	UCS	K.2.1
Chilton	Harrison		DC_M7731		K.2.1
Chin	Marilyn		DC_M6172	UCS	K.2.1
Chischilly	Jane		DC_M2583	UCS	K.2.1
Chisholm	Calum		DC_M0645		K.2.1
Chism	Stephen		DC_M2434	UCS	K.2.1
Chisolm	Ann		DC_M1066	UCS	K.2.1
Chitty	Wendy		DC_M3414	UCS	K.2.1
Chivers	Carol		DC_M3836	UCS	K.2.1
Chmieleski	Marian		DC_M3296	UCS	K.2.1
Choi	Irene		DC_M1276	UCS	K.2.1
Cholewa	Mitch		DC_M6063	UCS	K.2.1
Cholmar	Eve		DC_M2823	UCS	K.2.1
Cholson	Kirsti		DC_E0250		K.2.2
Chomat	Catherine		DC_M7111	UCS	K.2.1
Choplin	Diane		DC_M4193	UCS	K.2.1
Chou	Ya-Nan		DC_M1370	UCS	K.2.1
Chowdhury	Hamid		DC_M4137	UCS	K.2.1

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Christensen	Andrea		DC_M6789	UCS	K.2.1
Christensen-Burgess	Kevin	Tracy Christensen-Burgess	DC_M0092		K.2.1
Christiansen	David		DC_M3936	UCS	K.2.1
Christie	Paul		DC_M7499	UCS	K.2.1
Christie	Ruth		DC_E0047		K.3.1, K.3.2, K.3.12
Christman	Glenn		DC_M5090	UCS	K.2.1
Christopher	Bruce		DC_M3715	UCS	K.2.1
Christy	Alan		DC_M2093	UCS	K.2.1
Christy	Eileen		DC_M5823	UCS	K.2.1
Chu	Jon		DC_M4687	UCS	K.2.1
Chung	Christine		DC_M4596	UCS	K.2.1
Chung	Jeffrey		DC_M4128	UCS	K.2.1
Churchman	Pat		DC_M5876	UCS	K.2.1
Chynoweth	George		DC_M2688	UCS	K.2.1
Ciaccio	Marie		DC_M7343	UCS	K.2.1
Ciarrocca	Joe		DC_E0190		K.3.1
Ciavarella	Theresa		DC_M6091	UCS	K.2.1
Ciernia	Suzanna		DC_M0279		K.3.14
Cimiluca	Philip		DC_M1351	UCS	K.2.1
Cimino	Charlotte		DC_M4112	UCS	K.2.1
Cipher	Melanie		DC_M3883	UCS	K.2.1
Cipher	Melanie		DC_M5901	UCS	K.2.1
Cislo	Todd		DC_M7769		K.2.1
Claire	Insley		DC_E0048		K.3.2, K.3.7, K.3.11, K.3.12, K.3.15
Clark	Abigail		DC_M4998	UCS	K.2.1
Clark	Barbara		DC_E0170		K.3.14
Clark	Barbara		DC_M1197	UCS	K.2.1
Clark	Brian		DC_M3662	UCS	K.2.1
Clark	Carol		DC_M0661		K.2.1
Clark	Cindy		DC_M2896	UCS	K.2.1
Clark	Colleen		DC_M5822	UCS	K.2.1
Clark	Diane M		DC_M2219	UCS	K.2.1
Clark	Ejay		DC_M4681	UCS	K.2.1
Clark	John		DC_M1839	UCS	K.2.1
Clark	Kathy		DC_M4084	UCS	K.2.1
Clark	Lois		DC_M1699	UCS	K.2.1
Clark	Martha		DC_M4127	UCS	K.2.1
Clark	Martina		DC_M4232	UCS	K.2.1
Clark	Merrill		DC_M3619	UCS	K.2.1
Clark	Pamela		DC_M0469		K.2.1
Clark	Peter		DC_E0351		K.2.2
Clark	Robert		DC_E0396		K.2.2
Clark	Roselle		DC_M4072	UCS	K.2.1
Clark	Stacy		DC_M2510	UCS	K.2.1
Clark	Stacy		DC_M2553	UCS	K.2.1
Clark	Stuart		DC_M0653		K.2.1
Clark	Stuart		DC_M6717	UCS	K.2.1
Clark	Theresa		DC_M6137	UCS	K.2.1
Clark	Tim		DC_M0345		K.2.1
Clay	Margaret		DC_M5146	UCS	K.2.1
Claycomb	William		DC_M7822		K.2.1
Claypool	Roberta		DC_M2695	UCS	K.2.1
Clayton	Gwen		DC_M4292	UCS	K.2.1
Cleary	Steve		DC_PHO0038	Alaska PIRG	K.3.2, K.3.3, K.3.4, K.3.10, K.3.12, K.3.13, K.4
Cleland	Carrie		DC_M7783		K.2.1

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Clemens	Sydney Gurewitz		DC_M1528	UCS	K.2.1
Clement	Joe		DC_M6349	UCS	K.2.1
Clement	Suzette		DC_M5348	UCS	K.2.1
Clements	Peter		DC_M7778		K.2.1
Cleminson	Ron		DC_M2382	UCS	K.2.1
Clemmer	Janet		DC_M7344	UCS	K.2.1
Clendenen	Jason		DC_E0106		K.2.3
Clifton	Brigitte		DC_M7002	UCS	K.2.1
Cline	Michael		DC_M1384	UCS	K.2.1
Cline	Sherry		DC_M6797	UCS	K.2.1
Clinton	Ed & Jessie		DC_M2437	UCS	K.2.1
Clissold	David		DC_M1254	UCS	K.2.1
Cloner	Matthew		DC_M2792	UCS	K.2.1
Cloninger	John		DC_M4236	UCS	K.2.1
Cloud	Jennifer		DC_M4978	UCS	K.2.1
Clowney	David		DC_M7713		K.2.1
Clymo	Jerry		DC_M7288	UCS	K.2.1
Cobb	Stephen		DC_M2124	UCS	K.2.1
Coble	James		DC_M1920	UCS	K.2.1
Coburn	Bruce		DC_M5057	UCS	K.2.1
Cochrane	Steph		DC_M2678	UCS	K.2.1
Cockerill	Joanne		DC_M7073	UCS	K.2.1
Cocuzza	Douglas J.		DC_M4155	UCS	K.2.1
Coddon	Karin		DC_M5752	UCS	K.2.1
Coe	John		DC_M1853	UCS	K.2.1
Coffee	David		DC_M2596	UCS	K.2.1
Coffey	Morgan		DC_M4748	UCS	K.2.1
Coffey	Richard		DC_M4298	UCS	K.2.1
Cogswell	James		DC_M7138	UCS	K.2.1
Cohen	Alexandra		DC_M6399	UCS	K.2.1
Cohen	Anayansi		DC_M2857	UCS	K.2.1
Cohen	Benita		DC_M6164	UCS	K.2.1
Cohen	Claire		DC_E0165		K.2.3
Cohen	Nayana		DC_M6951	UCS	K.2.1
Cohen	Peter		DC_E0326		K.3.1, K.3.2, K.3.3, K.3.10, K.3.11, K.3.13, K.3.14, K.3.15, K.4
Cohen	Rajal		DC_M4048	UCS	K.2.1
Cohen	Sam		DC_M2470	UCS	K.2.1
Cohen	Ted		DC_M7568	UCS	K.2.1
Cohen	Todd		DC_M4859	UCS	K.2.1
Cohn	Carola		DC_M7266	UCS	K.2.1
Coker	Jason		DC_M7426	UCS	K.2.1
Colangelo	Annapoorne		DC_M4417	UCS	K.2.1
Colangelo	Annapoorne		DC_M7566	UCS	K.2.1
Cole	Barbara		DC_M4287	UCS	K.2.1
Cole	Bennett	Gabby Anderman	DC_M0260		K.2.1
Cole	Bertram		DC_M3148	UCS	K.2.1
Cole	Denise M.		DC_M4080	UCS	K.2.1
Cole	Denise M.		DC_M4148	UCS	K.2.1
Cole	Marian J		DC_M5152	UCS	K.2.1
Cole	Denise M.		DC_M0662		K.2.1
Coleman	Blaine		DC_M5562	UCS	K.2.1
Coleman	Elma		DC_PHO0047		K.4
Coleman	J.B.		DC_M7626	UCS	K.2.1
Coleman	Lorrie		DC_M2988	UCS	K.2.1
Coleman	Lorrie		DC_M2989	UCS	K.2.1
Coleman	Megan		DC_M0403		K.2.1

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Coleman	Peter		DC_M3698	UCS	K.2.1
Coleman	Stacey		DC_M3065	UCS	K.2.1
Coley	Deborah		DC_M3193	UCS	K.2.1
Coliver	Susan		DC_M1758	UCS	K.2.1
Coljohn	Kim		DC_M4527	UCS	K.2.1
Coll	Karen		DC_M2362	UCS	K.2.1
Colledge	Jeffrey		DC_M6106	UCS	K.2.1
Colley	Stephen		DC_M0591		K.2.1
Collier	Claudine		DC_M7529	UCS	K.2.1
Collier	Keli'i		DC_PHO0055		K.3.1, K.3.15, K.4
Collings	Andrew		DC_M4903	UCS	K.2.1
Collins	Amy		DC_M6679	UCS	K.2.1
Collins	Joseph		DC_M3801	UCS	K.2.1
Collins	Peggy S.		DC_M7183	UCS	K.2.1
Colon	Wendy		DC_M0547		K.2.1
Combs	Dianne		DC_M2562	UCS	K.2.1
Combs	Donald		DC_M5524	UCS	K.2.1
Combs	William L.		DC_M3392	UCS	K.2.1
Come	Lee		DC_M3608	UCS	K.2.1
Comer	Michael		DC_PHO0031		K.3.6, K.3.10, K.3.14, K.3.15
Comeskey	John		DC_M0904	UCS	K.2.1
Commer	Linda		DC_M5588	UCS	K.2.1
Compinsky	Dorothy		DC_M0084		K.2.1
Compton	Travis		DC_M4045	UCS	K.2.1
Comstock	Jean		DC_M4847	UCS	K.2.1
Cone	Nelson		DC_E0073		K.3.1, K.3.7
Cone	Richard		DC_M4465	UCS	K.2.1
Conger	Jean		DC_M0098		K.2.1
Conkle	Susan		DC_M7148	UCS	K.2.1
Conley	Geri		DC_M1734	UCS	K.2.1
Conley	James		DC_M0861	UCS	K.2.1
Conley	Michael		DC_M1906	UCS	K.2.1
Conn	Craig C.		DC_M1931	UCS	K.2.1
Connolly	Alyssa		DC_M3321	UCS	K.2.1
Connolly	Patricia		DC_M1591	UCS	K.2.1
Connor	Thomas		DC_M3742	UCS	K.2.1
Connors	Kathryn S.		DC_M6538	UCS	K.2.1
Conover	Ben		DC_M4101	UCS	K.2.1
Conroy	Kathleen		DC_M5068	UCS	K.2.1
Conroy	Nora		DC_M2575	UCS	K.2.1
Conroy	Peggy		DC_M7805		K.2.1
Constans	Mary Ann		DC_M5357	UCS	K.2.1
Conway	Dean		DC_M0179		K.3.14
Conway	Lauren		DC_M1791	UCS	K.2.1
Cook	Dagen		DC_M6221	UCS	K.2.1
Cook	James		DC_M0229		K.3.10, K.3.13, K.3.14
Cook	Jonathan		DC_M3589	UCS	K.2.1
Cook	Laura		DC_M3771	UCS	K.2.1
Cook	Liz		DC_M6030	UCS	K.2.1
Cook	Martha		DC_M5373	UCS	K.2.1
Cook	Morgan		DC_M5185	UCS	K.2.1
Cook	Robin		DC_M7936		K.2.3
Cook	William		DC_M5403	UCS	K.2.1
Cook-Carlton	Libby		DC_M1767	UCS	K.2.1
Cooke	Janet		DC_M2291	UCS	K.2.1
Cookman	Dick		DC_M2428	UCS	K.2.1
Cooney	Erin		DC_M5962	UCS	K.2.1
Cooney	Margaret		DC_M5438	UCS	K.2.1
Coonrod	Linda		DC_M7555	UCS	K.2.1

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Coons	Joel		DC_M6881	UCS	K.2.1
Cooper	James		DC_M0713		K.2.1
Cooper	Kelly		DC_M4620	UCS	K.2.1
Cooper	Maggie L.		DC_M3629	UCS	K.2.1
Cooper	Maury		DC_M3123	UCS	K.2.1
Cooper	Michael		DC_M1686	UCS	K.2.1
Cooper	Neil		DC_M0930	UCS	K.2.1
Cooper	Peter M.		DC_M1678	UCS	K.2.1
Cooper	Sandy		DC_M7143	UCS	K.2.1
Cooperman	Marcia		DC_M5654	UCS	K.2.1
Coopersmith	Jonathan		DC_M7792		K.2.1
Cope	Marcia		DC_M4930	UCS	K.2.1
Copeland	Albert		DC_M4363	UCS	K.2.1
Copeland	Damon		DC_M5858	UCS	K.2.1
Copeland	Lisa		DC_M1185	UCS	K.2.1
Copeland	Lisa		DC_M1341	UCS	K.2.1
Copeland	Patrice		DC_M3707	UCS	K.2.1
Copenagle	Lily		DC_M0725		K.2.1
Copes	Ken		DC_M1410	UCS	K.2.1
Copestakes	Vesta		DC_M7857		K.2.1
Corbin	Laurie		DC_M6635	UCS	K.2.1
Corbin	Linda		DC_M3395	UCS	K.2.1
Cordeau	Stephanie		DC_M6039	UCS	K.2.1
Cordell	Harold		DC_M7298	UCS	K.2.1
Corder	Peggy		DC_M3784	UCS	K.2.1
Cordes	Emily		DC_M1976	UCS	K.2.1
Cordes	Donald		DC_M2981	UCS	K.2.1
Cordova	Sherry		DC_M6032	UCS	K.2.1
Corley	Camie Foster		DC_M1425	UCS	K.2.1
Cornelius	Erin		DC_M1711	UCS	K.2.1
Cornell	Elizabeth		DC_M3015	UCS	K.2.1
Cornell	Steve		DC_M5720	UCS	K.2.1
Cornett	Paul		DC_E0372		K.3.4, K.3.7, K.3.10, K.3.11, K.3.12, K.3.13, K.3.14, K.3.15
Cornish	Rachel		DC_M4962	UCS	K.2.1
Cornwell	Charles		DC_E0385		K.3.5, K.3.6, K.3.11, K.3.12
Coronis	Laurence		DC_M1116	UCS	K.2.1
Corr	John F		DC_M3250	UCS	K.2.1
Correll	Nancy		DC_M2147	UCS	K.2.1
Corson	James M.		DC_M1162	UCS	K.2.1
Cortez	Chelle		DC_M4767	UCS	K.2.1
Cortinas	Jenni		DC_M5512	UCS	K.2.1
Corwin	Colette		DC_M5661	UCS	K.2.1
Cory	Christine		DC_M0127		K.2.1
Cosgriff	Mark		DC_M0391		K.2.1
Cosgriff	Mark		DC_M5984	UCS	K.2.1
Cosio	Paula		DC_M7939		K.2.1
Cosson	Ann		DC_M3665	UCS	K.2.1
Costa	Demelza		DC_M7099	UCS	K.2.1
Costello	Linda		DC_M4178	UCS	K.2.1
Cote	Katherine		DC_M6893	UCS	K.2.1
Cotter	Joe		DC_M6157	UCS	K.2.1
Cotton	Julie		DC_M3228	UCS	K.2.1
Cottrell	Duncan		DC_E0153		K.3.2, K.3.14
Couch	Courtney		DC_M1558	UCS	K.2.1
Coughlin	Barbara		DC_M4129	UCS	K.2.1
Couitt	Suzanne		DC_M5006	UCS	K.2.1
Coumoutso	Jill		DC_M5411	UCS	K.2.1
Courtenay	David		DC_M5526	UCS	K.2.1

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Courter	Mathew Russell		DC_M1042	UCS	K.2.1
Courtney	John		DC_M4385	UCS	K.2.1
Cousins	Vera		DC_M3527	UCS	K.2.1
Coutant	D		DC_M3141	UCS	K.2.1
Coutts	Bob		DC_M3642	UCS	K.2.1
Covello	Suzanne		DC_M6632	UCS	K.2.1
Cover	Esther		DC_M7206	UCS	K.2.1
Cowan	Kelly		DC_M0810	UCS	K.2.1
Cowan	Marian		DC_E0215		K.2.2
Cowley	Mary T		DC_M2560	UCS	K.2.1
Cox	Carol T.		DC_M1714	UCS	K.2.1
Cox	Catherine		DC_M2174	UCS	K.2.1
Cox	Douglas		DC_E0181		K.3.2, K.3.3, K.3.10, K.3.11, K.3.13
Cox	Jerry		DC_M0758		K.2.1
Cox	Julie		DC_M5514	UCS	K.2.1
Cox	Lesley		DC_E0257		K.2.2
Cox	Marilyn		DC_M6206	UCS	K.2.1
Cox	Michele Lee		DC_M0108		K.2.1
Cox	Rosemary		DC_M1238	UCS	K.2.1
Coyle	Philip		DC_E0318		K.3.9
Coyle	Philip		DC_PHO0026		K.3.4, K.3.12, K.3.14, K.3.15, K.4
Crabbe	Deborah		DC_M4349	UCS	K.2.1
Cracchiolo	Daniel		DC_M6310	UCS	K.2.1
Crady	Carrie		DC_M4502	UCS	K.2.1
Cragg	Noel		DC_M7408	UCS	K.2.1
Craig	David		DC_E0127		K.2.3
Craig	Eugene		DC_M5738	UCS	K.2.1
Craig	Frances		DC_M1204	UCS	K.2.1
Craig	George		DC_M7760		K.2.3
Craig	Paula		DC_M4179	UCS	K.2.1
Crain	WM D.		DC_M1460	UCS	K.2.1
Cramer	Craig S.		DC_M0111		K.2.1
Cramer	Mary Ann		DC_M4402	UCS	K.2.1
Crandall	Dean		DC_M6686	UCS	K.2.1
Crandell	Herbert C.		DC_M3648	UCS	K.2.1
Crane	Rita		DC_M4673	UCS	K.2.1
Crapo	Stan		DC_M0530		K.2.1
Craven	Mark		DC_M3692	UCS	K.2.1
Crawford	Adrian		DC_M5840	UCS	K.2.1
Crawford	Elizabeth		DC_E0399		K.3.9
Crawford	Louise		DC_M1335	UCS	K.2.1
Crawford	Lucas		DC_M3482	UCS	K.2.1
Crawford	Miriam		DC_E0193		K.2.2
Crawford	Morgan		DC_M3731	UCS	K.2.1
Crawford	Nancy		DC_M4805	UCS	K.2.1
Crawford	Tom	his father	DC_E0086		K.3.10
Creeley	Robert		DC_M6351	UCS	K.2.1
Creighton	Colleen		DC_M1289	UCS	K.2.1
Crenshaw	Aisha		DC_M4854	UCS	K.2.1
Cresseveur	Jessica		DC_M5699	UCS	K.2.1
Creswell	Joel		DC_M3164	UCS	K.2.1
Cribbin	Ruby A.		DC_M0117		K.2.1
Crickenberger	Ray		DC_M4463	UCS	K.2.1
Crimson	Beth		DC_M3443	UCS	K.2.1
Crisler	Patrick		DC_M6511	UCS	K.2.1
Crisp	William		DC_M6312	UCS	K.2.1
Crissman	Paul		DC_M0638		K.2.1

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Crist	Ed		DC_M5119	UCS	K.2.1
Crofut	Anni		DC_M1439	UCS	K.2.1
Crolius	Phyllis		DC_M0134		K.2.1
Crom	Nancy		DC_M5747	UCS	K.2.1
Crosby	Kimberely Michelle		DC_M6244	UCS	K.2.1
Cross	A. Donald		DC_M4237	UCS	K.2.1
Cross	Jay		DC_M6201	UCS	K.2.1
Cross	Joan		DC_E0161		K.3.1, K.3.10, K.3.15, K.4
Cross	Laurie		DC_M0278		K.3.1, K.3.2, K.3.3, K.3.4, K.3.11, K.3.12, K.3.15
Crouse	Mary Linn		DC_M3795	UCS	K.2.1
Crow	Laura		DC_M2594	UCS	K.2.1
Crowder	Tamara		DC_M2284	UCS	K.2.1
Crowley	Joyce		DC_M7211	UCS	K.2.1
Crowley	Joyce		DC_M7569	UCS	K.2.1
Crumbaugh	Jeff		DC_M1079	UCS	K.2.1
Cruz	Lynne		DC_M4746	UCS	K.2.1
Cruz	Marian		DC_M0099		K.2.1
Cruz	Marian		DC_M0389		K.2.1
Cruz	Marian		DC_M4810	UCS	K.2.1
Cseh	Zsolt		DC_M3088	UCS	K.2.1
Cubbage	Ruth		DC_M5249	UCS	K.2.1
Cubells	Joseph		DC_M5114	UCS	K.2.1
Cuellar	Vilma		DC_M0511		K.2.1
Culbertson	Brandy		DC_M0937	UCS	K.2.1
Culhane	Chuck		DC_M4663	UCS	K.2.1
Culley	Kathryn		DC_M3327	UCS	K.2.1
Culp	David		DC_E0404	Friends Committee on National Legislation	K.2.1
Culpepper	Pamela		DC_M3991	UCS	K.2.1
Cumming	Cheyne		DC_E0139		K.3.3, K.3.13
Cunningham	Kara		DC_M6285	UCS	K.2.1
Cunningham	Lynda		DC_M0032		K.2.1
Cunningham	Paul		DC_E0270		K.3.2, K.3.4, K.3.5, K.3.6, K.3.10, K.3.12, K.4
Cunningham	Richard		DC_M5939	UCS	K.2.1
Cunningham	Tim		DC_M1366	UCS	K.2.1
Cupp	Linda		DC_M0341		K.2.1
Curley	Susan		DC_M4692	UCS	K.2.1
Curotto	John		DC_M4461	UCS	K.2.1
Currie	Derek		DC_M3034	UCS	K.2.1
Curry	Joanne		DC_M4079	UCS	K.2.1
Curry	K.C.		DC_M0601		K.2.1
Curtin	Richard		DC_M3903	UCS	K.2.1
Curtis	Barbara		DC_M1622	UCS	K.2.1
Curtis	Joan		DC_M7302	UCS	K.2.1
Curtis	Mary Ruth		DC_M6568	UCS	K.2.1
Curtsinger	Lou		DC_M2348	UCS	K.2.1
Cushing	Therese		DC_M2826	UCS	K.2.1
Custer	Katherine		DC_M2013	UCS	K.2.1
Cygan	Denise		DC_M0701		K.2.1
Cyriacks	Christine		DC_M5010	UCS	K.2.1
D	Liz		DC_M5278	UCS	K.2.1
D.	Kavitha		DC_M7238	UCS	K.2.1
D.	Liz		DC_M7803		K.2.1
Da Silva Jain	Katherine		DC_M0222		K.2.1
Dacus	Chelsea		DC_M4912	UCS	K.2.1

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DaFonte	Humberto		DC_M3174	UCS	K.2.1
Dahl	Astrid		DC_M1046	UCS	K.2.1
Dahl	Martha J.		DC_M7468	UCS	K.2.1
Dahlgren	James		DC_M5887	UCS	K.2.1
Dahlquist	Jean		DC_M6198	UCS	K.2.1
Dahringer	Nan		DC_M7004	UCS	K.2.1
Daigle	Deborah		DC_M2576	UCS	K.2.1
Daigle	Ralph		DC_M0554		K.2.1
Daigneault	Larry		DC_M5554	UCS	K.2.1
Daily	Janet		DC_M1041	UCS	K.2.1
Daims	Mark		DC_M4778	UCS	K.2.1
Daiss	Becky		DC_M6011	UCS	K.2.1
Dale	Emily		DC_M4344	UCS	K.2.1
D'Alessio	David		DC_M0572		K.2.1
D'Alessio	David		DC_M3374	UCS	K.2.1
Dalsemer	Terry		DC_M6584	UCS	K.2.1
Dalto	Carol Ann		DC_M0940	UCS	K.2.1
Daly	Kimberly		DC_M0807	UCS	K.2.1
Daly	Linda		DC_M3649	UCS	K.2.1
Daly	Linda		DC_M6701	UCS	K.2.1
Dame	Marilyn		DC_M1214	UCS	K.2.1
D'Amelio	Vanessa		DC_M7034	UCS	K.2.1
Dames	Jeff		DC_M4771	UCS	K.2.1
Damesek	Harriet		DC_M3595	UCS	K.2.1
Damico	Ron		DC_M4141	UCS	K.2.1
D'Amico	Mary		DC_M0876	UCS	K.2.1
Damien	Paul		DC_M4372	UCS	K.2.1
D'Amo	Philip		DC_M4685	UCS	K.2.1
Damon	Eric		DC_M2634	UCS	K.2.1
Danforth	Janet		DC_M0549		K.2.1
Dangelo	Joseph		DC_M3870	UCS	K.2.1
D'Angelo	Guy		DC_M3685	UCS	K.2.1
D'Angelo	Joseph		DC_M5686	UCS	K.2.1
Dangerfield	Dorothy Shays		DC_M5504	UCS	K.2.1
Daniel	Clay		DC_E0168		K.3.7, K.3.14
Daniel	E.E.		DC_E0185	Department of Pharmacolgoy U. Alberta	K.3.2, K.3.7, K.3.10, K.3.11, K.3.15
Daniel	Robert	Kathryn Daniel	DC_E0306		K.3.2, K.3.3, K.3.7, K.3.13
Danielle	Summerville-White		DC_E0022		K.2.2
Daniels	Alathea		DC_M5139	UCS	K.2.1
Daniels	Edwin		DC_M1596	UCS	K.2.1
Daniels	Elizabeth		DC_M0506		K.2.1
Daniels	J Scott		DC_M5454	UCS	K.2.1
Daniels	Laura		DC_E0232		K.2.2
Daniels	Walter		DC_M0455		K.2.1
Daniels	William		DC_M2302	UCS	K.2.1
Danielson	Amy		DC_M3063	UCS	K.2.1
D'Anna	Marie		DC_M3375	UCS	K.2.1
Dannacher	Pamela		DC_M0463		K.2.1
Dano	Eylene		DC_M5989	UCS	K.2.1
Danowski	Kristine		DC_M7152	UCS	K.2.1
Dantis	Denise		DC_M2735	UCS	K.2.1
Danziger	Michael		DC_M0428		K.2.1
D'Arcangelo	Dawn		DC_M5141	UCS	K.2.1
Dare	Cheryl		DC_M1022	UCS	K.2.1
Darnall	Diann		DC_M0845	UCS	K.2.1
Darnell	Cathy		DC_M3329	UCS	K.2.1

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Darr	Edyce		DC_M4793	UCS	K.2.1
Darrar	James		DC_M4946	UCS	K.2.1
Darrow	Eric		DC_M1266	UCS	K.2.1
Darwish	Amal		DC_M7405	UCS	K.2.1
DaSilva	Steven		DC_M3873	UCS	K.2.1
Dattner	Eric		DC_M5099	UCS	K.2.1
Datz	Sheila		DC_M3298	UCS	K.2.1
Daugherty	Ellen		DC_M5159	UCS	K.2.1
Daugherty	Tamara		DC_M2444	UCS	K.2.1
Daughtry-Weiss	Lisa		DC_M1512	UCS	K.2.1
Dauwalter	Christine		DC_M2287	UCS	K.2.1
Davey	Judy		DC_M2300	UCS	K.2.1
Davidson	Linda		DC_M2482	UCS	K.2.1
Davidson	Raighne		DC_M3782	UCS	K.2.1
Davies	J. Che'		DC_M0998	UCS	K.2.1
Davies	Nancy		DC_M1923	UCS	K.2.1
Davis	Candace		DC_M1220	UCS	K.2.1
Davis	Cynthia		DC_M2502	UCS	K.2.1
Davis	Davis		DC_M0613		K.2.1
Davis	Jennifer		DC_M0242		K.2.2
Davis	Jenny		DC_M6169	UCS	K.2.1
Davis	John		DC_M0501		K.2.1
Davis	Kate		DC_M0887	UCS	K.2.1
Davis	Larry		DC_M0146		K.2.1
Davis	Liza		DC_M0962	UCS	K.2.1
Davis	Lynn		DC_M7818		K.2.1
Davis	Margot L.		DC_M4902	UCS	K.2.1
Davis	Marion		DC_M7824		K.2.1
Davis	Mary		DC_M4390	UCS	K.2.1
Davis	P. Thompson		DC_M6680	UCS	K.2.1
Davis	Perry		DC_M1004	UCS	K.2.1
Davis	Robin		DC_M6684	UCS	K.2.1
Davis	Steve		DC_M7751		K.2.1
Davis	Susan		DC_M2293	UCS	K.2.1
Davis	Terrence		DC_M2628	UCS	K.2.1
Davis	Thomas		DC_M2531	UCS	K.2.1
Davis	TJ		DC_M1803	UCS	K.2.1
Davis	Todd		DC_M2010	UCS	K.2.1
Davis	Wendy Hale		DC_M7383	UCS	K.2.1
Davis	Y.		DC_M0954	UCS	K.2.1
Dawn	Loren		DC_M2500	UCS	K.2.1
Dawson	Kia		DC_M6447	UCS	K.2.1
Day	Faye		DC_M0882	UCS	K.2.1
Day	Joyce		DC_M7165	UCS	K.2.1
Day	Linda		DC_M2453	UCS	K.2.1
Day	M. Jeroma		DC_M0269		K.3.2, K.3.3, K.3.7
Day	Michael		DC_M1210	UCS	K.2.1
Day	Theresa		DC_M5203	UCS	K.2.1
Daye	Rev. Katherine H		DC_M2770	UCS	K.2.1
Daykin	Jeanne		DC_M0997	UCS	K.2.1
Dayton	Beverly		DC_M5621	UCS	K.2.1
Dayton	Norma		DC_M3723	UCS	K.2.1
de Boer	Chiquita		DC_M1348	UCS	K.2.1
de Cosmo-Carroll	Jacqueline		DC_M3302	UCS	K.2.1
De Costa	Lawrence		DC_M2931	UCS	K.2.1
De Costa	Lawrence		DC_M5819	UCS	K.2.1
De Jasu	Barry		DC_M2672	UCS	K.2.1
De Jesus	Monique		DC_M2046	UCS	K.2.1

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de Jong	Marie		DC_M3267	UCS	K.2.1
de Jong	Marie		DC_M3322	UCS	K.2.1
de la Fuente	Chrinstina		DC_M4862	UCS	K.2.1
De Lu	Darien		DC_E0380		K.4
de Pujo	Frederic		DC_M6889	UCS	K.2.1
de Robbio	Elisabetta		DC_M4268	UCS	K.2.1
De Roin	Virginia		DC_M2656	UCS	K.2.1
De Smedt	Sandra		DC_M2976	UCS	K.2.1
de Streel	Nancy		DC_M1843	UCS	K.2.1
de Wolfe	Natashja		DC_M5575	UCS	K.2.1
Deacon	James		DC_M2155	UCS	K.2.1
Dean	Allison		DC_M2779	UCS	K.2.1
Dean	John		DC_M5586	UCS	K.2.1
Dean	Kristi		DC_M6670	UCS	K.2.1
Dean	Liama		DC_M3929	UCS	K.2.1
Dean	Nancy		DC_M6825	UCS	K.2.1
Dean	Patricia		DC_M1423	UCS	K.2.1
Dean	Rachel		DC_M7230	UCS	K.2.1
Dean	Sharon		DC_M3368	UCS	K.2.1
Dean	Sue E.		DC_M0761		K.2.1
Dean	Susan		DC_M1516	UCS	K.2.1
Dean	Rosamond		DC_M5020	UCS	K.2.1
Debasitis	Brian		DC_M4328	UCS	K.2.1
DeBing	Therese		DC_M4428	UCS	K.2.1
DeCaprio	Alexis		DC_M5362	UCS	K.2.1
DeCarlo	George		DC_M0135		K.2.1
Decker	Dorothy		DC_M5122	UCS	K.2.1
Decker	Mary Gail		DC_M6470	UCS	K.2.1
Deering	Beverly		DC_M7279	UCS	K.2.1
DeFalco	Tony		DC_M5048	UCS	K.2.1
DeFilippo	Lynn		DC_M1455	UCS	K.2.1
DeFrancesco	Susan		DC_M1441	UCS	K.2.1
Deftereos	Pallo		DC_PHO0012	Sacramento Committee for Nuclear Arms Control	K.3.1, K.3.5, K.3.15
Deftereos	Pallo		DC_PHW0007		K.3.9
DeGallier	Glenn		DC_M2118	UCS	K.2.1
deGero	Beverly		DC_M2216	UCS	K.2.1
DeGiuseppi	MaryJo		DC_M3644	UCS	K.2.1
Dehnbostel	Gemma		DC_M7647	UCS	K.2.1
D'Eilia	Joe		DC_E0337		K.3.9
Deirdre	Griffin		DC_E0280		K.3.3, K.3.12
Deisz	John		DC_M1152	UCS	K.2.1
DeJonghe	Mark	Juli	DC_M0827	UCS	K.2.1
del Castillo	Concepcion		DC_M2618	UCS	K.2.1
DeLaBarre	Elizabeth		DC_M0541		K.2.1
Delaney	Millie		DC_M3988	UCS	K.2.1
Delau	Katy		DC_M1403	UCS	K.2.1
Delcort	Benoit		DC_M3693	UCS	K.2.1
DeLeon	Ed		DC_M7350	UCS	K.2.1
Delevoryas	Penelope		DC_M4243	UCS	K.2.1
DeLeys	Robert		DC_M6313	UCS	K.2.1
del'Giudice	Janet		DC_M4907	UCS	K.2.1
DellaFemina	Peter		DC_M1470	UCS	K.2.1
delPino	Rosemary		DC_M4404	UCS	K.2.1
Delsemme	Jacques		DC_M5969	UCS	K.2.1

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Delu	Darien		DC_PHO0018	Women's International League for Peace and Freedom, United States Section	K.3.4, K.3.5, K.3.11, K.3.13, K.3.15, K.4
Deming	Deborah		DC_M3703	UCS	K.2.1
Demirgian	Elizabeth		DC_M3533	UCS	K.2.1
Dempsey	Isa		DC_M7581	UCS	K.2.1
Demski	Eileen		DC_M3819	UCS	K.2.1
Dene	David		DC_E0103		K.2.2
Denham	Isabel		DC_E0406		K.3.1, K.3.2, K.3.4, K.3.12, K.3.13
DeNicola	Jo-Ellen		DC_M2267	UCS	K.2.1
Denio	Allen		DC_M1778	UCS	K.2.1
Denio	Amy		DC_M7112	UCS	K.2.1
Denley	Walter E		DC_M3382	UCS	K.2.1
Denman	Jack	Margarita Denman	DC_M4066	UCS	K.2.1
Denneen	Bill		DC_M0128		K.2.1
Dennis	Larry		DC_M4938	UCS	K.2.1
Dennis	Todd E.		DC_M1827	UCS	K.2.1
Denny	Rachael		DC_M2648	UCS	K.2.1
Denslow	Estelle		DC_M1514	UCS	K.2.1
Denslow	Estelle		DC_M1515	UCS	K.2.1
Dent	William		DC_M2785	UCS	K.2.1
Dentel	Ann		DC_M4270	UCS	K.2.1
Denton	Joan		DC_M1749	UCS	K.2.1
DePauw	Jolie		DC_M6419	UCS	K.2.1
Derby	Nina		DC_M2601	UCS	K.2.1
Desbrow	Stacy		DC_M1701	UCS	K.2.1
Desfor	Paul		DC_M6415	UCS	K.2.1
DesJardins	Paul		DC_M1755	UCS	K.2.1
DeSpain	Juell		DC_M7091	UCS	K.2.1
Desreuisseau	Judy		DC_M4652	UCS	K.2.1
Dessain	Ronald		DC_M0759		K.2.1
Detwieler	Winnie		DC_PHO0032	Sacramento Area Peace Action	K.3.2, K.3.4, K.3.5, K.3.6, K.3.10, K.3.11, K.3.13, K.3.14, K.3.15, K.4
Detwiler	Winnie		DC_PHW0005		K.3.1, K.3.2, K.3.4, K.3.5, K.3.6, K.3.10, K.3.11, K.3.13, K.3. 14, K.3.15, K.4
Deutsch	Trudy		DC_M3387	UCS	K.2.1
Devasto	Ginny		DC_M4880	UCS	K.2.1
Devine	Dewey		DC_M3451	UCS	K.2.1
Devitt	Ed		DC_M5874	UCS	K.2.1
Devitt	Ed		DC_M6357	UCS	K.2.1
Devlin	Melissa		DC_M1462	UCS	K.2.1
DeVore	William		DC_M4591	UCS	K.2.1
Dewey	Laura		DC_M0022		K.3.2, K.3.3, K.3.5, K.3.11, K.3.12, K.3.15
DeWit	Fred		DC_M1761	UCS	K.2.1
Dexter	Dawn		DC_M6474	UCS	K.2.1
Dexter	Suzan	Ted Burik	DC_M0147		K.2.1
Dial	Jennifer		DC_M5532	UCS	K.2.1
Diamond	Karen		DC_M2185	UCS	K.2.1
Diaz	Natalie		DC_M6728	UCS	K.2.1
Dibble	Marcia C.		DC_M0959	UCS	K.2.1
DiCara	Sue		DC_M1329	UCS	K.2.1
DiCato	Leilani		DC_M6026	UCS	K.2.1
Dick	Kathy		DC_M5346	UCS	K.2.1

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Dick	R		DC_M6938	UCS	K.2.1
Dickerson	Birgitta		DC_M6245	UCS	K.2.1
Dickinson	Matt		DC_M2885	UCS	K.2.1
Dickson	Gloria		DC_M6956	UCS	K.2.1
DiDiano	Marisa		DC_M6274	UCS	K.2.1
Diehl	Chris		DC_M0830	UCS	K.2.1
Diel	Bryon		DC_PHO0030	Peace Fresno and Superfluid Helium 3 (a band)	K.3.2, K.3.6, K.3.10, K.3.12, K.3.15
Diesel	Sandra		DC_M3816	UCS	K.2.1
Dietrick	Janet		DC_E0125		K.3.1, K.3.14
Dietz	David		DC_M2873	UCS	K.2.1
Dietz	Kerry		DC_M4571	UCS	K.2.1
Dietz	Sally		DC_M3003	UCS	K.2.1
DiFiore	Maria		DC_M4758	UCS	K.2.1
DiGenova	Shannon		DC_M4889	UCS	K.2.1
Digou	Carol		DC_M1310	UCS	K.2.1
DiLabio	Gena		DC_E0341		K.3.2, K.3.7, K.3.10, K.3.11, K.3.12, K.3.15
Dillberg	David		DC_M5774	UCS	K.2.1
Diller	Jeanne V.		DC_M4338	UCS	K.2.1
Dilley	Maxx		DC_M0263		K.3.1, K.3.2, K.3.3, K.3.10, K.3.13, K.3.14
Dillon	Fred		DC_M5208	UCS	K.2.1
DiMatteo	Richard		DC_M0722		K.2.1
Dimin	Lee		DC_M7723		K.2.1
Dimin	Lee		DC_M7853		K.2.1
Dineen	Katherine		DC_M2694	UCS	K.2.1
Dingman	Jane		DC_M6908	UCS	K.2.1
DiRisio	Joe		DC_M1951	UCS	K.2.1
DiRodio	Matthew		DC_M5735	UCS	K.2.1
Dishman	Benjamin		DC_M1938	UCS	K.2.1
Disque	Melinda		DC_M1727	UCS	K.2.1
Dixon	Alice		DC_M3652	UCS	K.2.1
Dixon	David		DC_M1492	UCS	K.2.1
Dixon	Donald		DC_M4933	UCS	K.2.1
Dixon	John		DC_M2558	UCS	K.2.1
Dixon	Lynne		DC_M5904	UCS	K.2.1
Dockendorf	Lori		DC_M2493	UCS	K.2.1
Dockter	Jeremy		DC_M2754	UCS	K.2.1
Dodds	Debra		DC_M4497	UCS	K.2.1
Dodge	Fred		DC_PHO0059		K.3.1, K.3.2, K.3.3, K.3.4, K.3.6, K.3.10, K.3.11, K.3.13, K.3.15, K.4
Doe	R. Renee		DC_M6803	UCS	K.2.1
Doeden	Jon W.		DC_M2416	UCS	K.2.1
Doherty	Trish		DC_M6993	UCS	K.2.1
Dolinko	Paul		DC_M5157	UCS	K.2.1
Dolney	Rachel		DC_M0570		K.2.1
Dolnick	Cody		DC_M6756	UCS	K.2.1
Domina	Linda		DC_M5123	UCS	K.2.1
Dominguez	Fernando Buen Abad		DC_M3933	UCS	K.2.1
Dominguez	Laura		DC_M0909	UCS	K.2.1
Dominica	Susan		DC_M3247	UCS	K.2.1
Donahue	Nona		DC_M2072	UCS	K.2.1
Donahue	Robert		DC_M3543	UCS	K.2.1
Donaldson	Jamie K.		DC_E0129		K.3.2, K.3.4, K.3.10, K.3.12
Donatoni	Matthew		DC_M5465	UCS	K.2.1

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Donin	Eric		DC_M0300		K.2.1
Donley	Michelle		DC_M3277	UCS	K.2.1
Donnell	Jane		DC_M2254	UCS	K.2.1
Donnelly	Sam		DC_M3615	UCS	K.2.1
Donohoe	Martin		DC_E0148		K.2.2
Donohue	Carol		DC_E0305		K.3.1, K.3.3
Donohue	Eugene		DC_M6109	UCS	K.2.1
Donovan	Dave		DC_M6179	UCS	K.2.1
Donovan	David		DC_M3224	UCS	K.2.1
Donsbach	Carl		DC_M0333		K.2.1
Donsbach	Carl		DC_M5580	UCS	K.2.1
Donston	Kacey		DC_M2893	UCS	K.2.1
Doocy	Audrey		DC_M7451	UCS	K.2.1
Dooley	Scott		DC_M2415	UCS	K.2.1
Doost	Kay		DC_M0286		K.3.14
Doran	Jean		DC_M4371	UCS	K.2.1
Doran	Lori		DC_M6454	UCS	K.2.1
Doran	Patricia		DC_M3605	UCS	K.2.1
Dorner	Catherine		DC_M2473	UCS	K.2.1
Doros	Cheryl		DC_M1838	UCS	K.2.1
Dorris	Mary		DC_M2055	UCS	K.2.1
Dorsett	Felicity		DC_M5312	UCS	K.2.1
Dorton	Beth		DC_M1353	UCS	K.2.1
Dorweiler	Anne		DC_M0249		K.3.2, K.3.14
Doten	Meg		DC_M2582	UCS	K.2.1
Doucet	B.J.		DC_M3423	UCS	K.2.1
Doucet	Lisha		DC_M4730	UCS	K.2.1
Dougherty	Mona		DC_M1281	UCS	K.2.1
Dougherty	Ruby D		DC_M7582	UCS	K.2.1
Douglas	Linda		DC_M0282		K.3.2, K.3.13, K.3.14
Douglas	Matt		DC_M3154	UCS	K.2.1
Douglas	Rosealie		DC_M3364	UCS	K.2.1
Douglas	Edward		DC_M6084	UCS	K.2.1
Douglass	Terri		DC_M6029	UCS	K.2.1
Dove	Donna		DC_M4472	UCS	K.2.1
Dow	Duncan		DC_M0011		K.3.3, K.3.4, K.3.6, K.3.7, K.3.11, K.3.12
Dowell	Chet		DC_M7177	UCS	K.2.1
Dowling	Dave		DC_M5773	UCS	K.2.1
Downer	Vesta		DC_M5205	UCS	K.2.1
Downie	John		DC_M4199	UCS	K.2.1
Downing	Kenneth N.		DC_M3769	UCS	K.2.1
Downs	Patricia		DC_M3766	UCS	K.2.1
Doyle	Christine		DC_E0346	Simply Herbs Workers Collective	K.3.2, K.3.3, K.3.4, K.3.6, K.3.7, K.3.11, K.3.15
Doyle	Kathleen		DC_M2836	UCS	K.2.1
Doyle	Mary Anne		DC_E0274		K.3.2, K.3.3, K.3.10, K.3.12
Doyle	Shannon		DC_M4918	UCS	K.2.1
Drager	Annie		DC_M6769	UCS	K.2.1
Drake	Christy		DC_M3584	UCS	K.2.1
Drake	Cindi		DC_M6134	UCS	K.2.1
Draper	Janet		DC_M2079	UCS	K.2.1
Draudt	Dave		DC_E0237		K.2.2
Draudt	Dave		DC_P0007		K.2.2
Drea	Christine		DC_M6095	UCS	K.2.1
Drevicky	John		DC_M4579	UCS	K.2.1
Dreyer	Elanor		DC_M0250		K.3.2, K.3.7, K.3.11, K.3.15
Dreyer	Ellen		DC_E0308		K.2.2
Dreyer	Lu		DC_E0235		K.2.2

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Dries	Paul		DC_M3126	UCS	K.2.1
Drinkwater	Laurie		DC_M6939	UCS	K.2.1
Drischoll	Laura		DC_M7133	UCS	K.2.1
Driscoll	Jim		DC_E0057		K.3.7
Drobnik	Margaret		DC_M7201	UCS	K.2.1
Drohan	Lori		DC_M7669	UCS	K.2.1
Dryden	Robertson		DC_M2401	UCS	K.2.1
Dryer	Marilyn		DC_M0028		K.3.7, K.3.11, K.3.15
Du Mond	Glenna		DC_M7258	UCS	K.2.1
Dubbeldam	Marc		DC_M5368	UCS	K.2.1
Dube	Cindy		DC_M2768	UCS	K.2.1
duBrin	Jane		DC_M3113	UCS	K.2.1
Duck	Denise		DC_M2847	UCS	K.2.1
DuClaud	Monica		DC_M3289	UCS	K.2.1
Dudash	Doris		DC_M1275	UCS	K.2.1
Dudeck	Michelle		DC_M4439	UCS	K.2.1
Dudeck	Michelle		DC_M6433	UCS	K.2.1
Dudrick	Roseann		DC_M0721		K.2.1
Duenow	Lisa Renee		DC_M3340	UCS	K.2.1
Dufresne	JC		DC_M1236	UCS	K.2.1
Dugar	Alice		DC_M2620	UCS	K.2.1
Duggan	Joan		DC_M5855	UCS	K.2.1
Duink	Amy		DC_M1887	UCS	K.2.1
Dulicai	Dianne		DC_M1620	UCS	K.2.1
Dumbleton	Marilyn		DC_M4361	UCS	K.2.1
Dunar	Edward		DC_M6634	UCS	K.2.1
Duncan	Larissa		DC_M2432	UCS	K.2.1
Duneman	Gary		DC_M6395	UCS	K.2.1
Dunlap	Anne		DC_M5460	UCS	K.2.1
Dunmore	Ralph		DC_M0515		K.2.1
Dunn	Eddy		DC_M2641	UCS	K.2.1
Dunn	Mary		DC_E0304		K.2.2
Dunn	Michelle		DC_M1296	UCS	K.2.1
Dunn	Robert		DC_M3495	UCS	K.2.1
Dunn	Sheryl		DC_M0833	UCS	K.2.1
Dunn	Sheryl		DC_M5521	UCS	K.2.1
Dunne	Loretta		DC_M0287		K.3.1, K.3.10, K.3.14
Dunseath	Hugh		DC_M2571	UCS	K.2.1
Dupont	CJ		DC_M4384	UCS	K.2.1
Duprey	Renee		DC_M3480	UCS	K.2.1
Durand	Marie		DC_M6283	UCS	K.2.1
Durante	Grant R		DC_M6841	UCS	K.2.1
Durham	Crystal		DC_M6960	UCS	K.2.1
Durling	Teresa		DC_M5081	UCS	K.2.1
Durston	Bill		DC_PHO0014		K.3.1, K.3.2, K.3.4, K.3.11, K.3.12, K.3.15, K.4
Durston	William		DC_PHW0009		K.3.4, K.3.5, K.3.9, K.3.11, K.3.12, K.3.15, K.4
Dushkind	Winnie		DC_M0205		K.3.14
Duttlinger	Pierre		DC_M7617	UCS	K.2.1
DuVall	Judith		DC_M7590	UCS	K.2.1
Duxbury	Mitzi		DC_M3728	UCS	K.2.1
Dvorak	Eleanor		DC_M6530	UCS	K.2.1
Dwight	Eleanor		DC_M0029		K.3.2, K.3.3, K.3.7, K.3.12, K.3.15
Dwyer	Daniel		DC_M4564	UCS	K.2.1
Dwyer	Kerry		DC_M5268	UCS	K.2.1
Dwyer	Suzanna		DC_M2032	UCS	K.2.1
Dyas	Melissa		DC_M6341	UCS	K.2.1

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Dye	Joyce		DC_M5351	UCS	K.2.1
Dyer	Michel		DC_M6902	UCS	K.2.1
Dymkowski	Evelyn J.		DC_M7927		K.2.1
E	Russ		DC_M2303	UCS	K.2.1
Eaden	Denise		DC_M2192	UCS	K.2.1
Eames	Wendy		DC_M5640	UCS	K.2.1
Earl	Carina Alia		DC_M4234	UCS	K.2.1
Earle	Nancy		DC_M0753		K.2.1
Early	Gordon		DC_M6604	UCS	K.2.1
Earth	John		DC_M0814	UCS	K.2.1
Eash	David		DC_M3778	UCS	K.2.1
Easley	Judah Joy		DC_M5148	UCS	K.2.1
Easom	Colin		DC_M4994	UCS	K.2.1
Easter	Bunny		DC_M5130	UCS	K.2.1
Easter	Shane		DC_E0169		K.3.14
Eastlake	Brenda		DC_M1918	UCS	K.2.1
Easton	Rick		DC_M3259	UCS	K.2.1
Eaton	Barbara		DC_M7172	UCS	K.2.1
Eaton	Rose		DC_M1957	UCS	K.2.1
Ebbink	M.J.P		DC_M4413	UCS	K.2.1
Eberhard	Darielle		DC_M6099	UCS	K.2.1
Ebersole	Laurence		DC_E0179		K.3.1, K.3.2, K.3.3, K.3.4, K.3.5, K.3.6, K.3.11, K.3.15, K.4
Ebey	Christopher		DC_M7182	UCS	K.2.1
Eck	Daniel		DC_M3239	UCS	K.2.1
Eck	Laura Tyler		DC_M0938	UCS	K.2.1
Eck	Paul		DC_M0458		K.2.1
Eckel	Nancy		DC_M7277	UCS	K.2.1
Eckert	Janice		DC_E0290		K.3.2, K.3.14
Ecklund	Lars A.		DC_M3834	UCS	K.2.1
Eddy	Kevin		DC_M4971	UCS	K.2.1
Eddy	MacGregor		DC_PHO0009	advisory board member-Network Against Weapons and Nuclear Power in Space regardign the BMDS PEIS	K.3.3, K.3.4, K.3.11, K.3.12, K.4
Eddy	MacGregor		DC_PHW0006		K.3.4, K.3.11, K.3.15, K.4
Edelstein	Susan		DC_M0313		K.2.1
Eden	Scott		DC_M4186	UCS	K.2.1
Edgecomb	Jean		DC_M7009	UCS	K.2.1
Edison	Kevin		DC_M2968	UCS	K.2.1
Edlin	Maidland		DC_M5847	UCS	K.2.1
Edmonds	Barbara		DC_M1028	UCS	K.2.1
Edmonston	Donald		DC_M1142	UCS	K.2.1
Edmonston	Jack		DC_M7715		K.2.1
Edwards	Burke		DC_M7601	UCS	K.2.1
Edwards	Erin		DC_M5902	UCS	K.2.1
Edwards	Floyd		DC_M3342	UCS	K.2.1
Edwards	J.		DC_M5189	UCS	K.2.1
Edwards	Sherry		DC_M7424	UCS	K.2.1
Egain	Mollie		DC_M6254	UCS	K.2.1
Egan	Charlotte		DC_M4031	UCS	K.2.1
Egan	Elecia		DC_M7441	UCS	K.2.1
Egan	Sara		DC_M6736	UCS	K.2.1
Egbert	Susan		DC_M0408		K.2.1
Egen	Ned		DC_M3860	UCS	K.2.1
Eger	Jonathan		DC_M1023	UCS	K.2.1

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Eggleston	Margaret		DC_M5709	UCS	K.2.1
Ehrgott	Fred		DC_M5854	UCS	K.2.1
Ehrlich	Annette		DC_M5566	UCS	K.2.1
Eichenlaub	Connie		DC_M0394		K.2.1
Eichenlaub	Connie		DC_M3979	UCS	K.2.1
Eichler	Gina		DC_M3534	UCS	K.2.1
Eis	Mark		DC_M4939	UCS	K.2.1
Eisenberg	Ned		DC_M3220	UCS	K.2.1
Eisenberg	Nicol		DC_M0112		K.2.1
Ekenstam	Karon		DC_M2906	UCS	K.2.1
Ekstrom	Edwina		DC_M5229	UCS	K.2.1
Ekvinai	Penny		DC_M5378	UCS	K.2.1
El Masri	Judy		DC_M3803	UCS	K.2.1
Elaine	Dellande		DC_M5746	UCS	K.2.1
Elam	Barb		DC_M4325	UCS	K.2.1
El-Badry	Nadia		DC_M2085	UCS	K.2.1
Eldred	Neil		DC_M4457	UCS	K.2.1
Eldredge	Jeri		DC_M1559	UCS	K.2.1
Eldridge	Sherry		DC_M2775	UCS	K.2.1
Elgin	Dr. Robert		DC_M6089	UCS	K.2.1
Elio	Joel		DC_M5692	UCS	K.2.1
Eliot	Arthur		DC_M1676	UCS	K.2.1
Elkington	Harriet		DC_M7532	UCS	K.2.1
Ellenburg	DL		DC_M6380	UCS	K.2.1
Ellingbee	Randi		DC_M5844	UCS	K.2.1
Elliot	Miriam		DC_E0411		K.3.4, K.3.11, K.3.12
Elliott	Erica		DC_M7586	UCS	K.2.1
Elliott	Julie		DC_M4653	UCS	K.2.1
Elliott	Michael		DC_M3710	UCS	K.2.1
Ellis	Cathy		DC_M1724	UCS	K.2.1
Ellis	Dale		DC_M2108	UCS	K.2.1
Ellis	David		DC_M6575	UCS	K.2.1
Ellis	Gloria		DC_M3468	UCS	K.2.1
Ellis	Heidi		DC_M7274	UCS	K.2.1
Ellis	Jennifer		DC_M5841	UCS	K.2.1
Ellis	Joseph		DC_M4221	UCS	K.2.1
Ellis	Linda		DC_M4845	UCS	K.2.1
Ellis	Rob		DC_M0085		K.2.2
Ellis	Robert		DC_M6306	UCS	K.2.1
Ellison	Mark		DC_M1628	UCS	K.2.1
Ellison-Hanks	Johanna		DC_M5564	UCS	K.2.1
Ellman	Chana		DC_M7871		K.3.5, K.3.7, K.3.13
Ellsworth	Frederick		DC_M2326	UCS	K.2.1
Ellsworth	Linda		DC_M5704	UCS	K.2.1
Ellyn	Maura		DC_M1304	UCS	K.2.1
Elness	Barbara		DC_M6587	UCS	K.2.1
Elsbach	Peter		DC_M4623	UCS	K.2.1
Else	Victoria		DC_M1540	UCS	K.2.1
Emad	Victoria		DC_M7567	UCS	K.2.1
Emery	Melinda		DC_M1092	UCS	K.2.1
Emery	Melinda		DC_M2163	UCS	K.2.1
Emery	Michael		DC_M3840	UCS	K.2.1
Emetarom	Chitoh		DC_M4633	UCS	K.2.1
Emmett	Mike		DC_M5032	UCS	K.2.1
Enciso	Violeta		DC_M4025	UCS	K.2.1
Endo	Gayle		DC_M5534	UCS	K.2.1
Enevoldsen	David		DC_M7947		K.2.3
Enfield	Jackie		DC_M5138	UCS	K.2.1
Engel	Jane		DC_M7584	UCS	K.2.1

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Engelman	Marilin		DC_M7596	UCS	K.2.1
Engert	Kathy M.		DC_M1475	UCS	K.2.1
Engler	Grace		DC_M3439	UCS	K.2.1
English	Nicole		DC_M6108	UCS	K.2.1
English	Thomas		DC_M0964	UCS	K.2.1
Engman	Eloise		DC_M7486	UCS	K.2.1
Ennes	Howard		DC_M7934		K.3.3, K.3.10, K.3.11, K.3.13, K.3.14, K.3.15
Enright	Lynda		DC_M5560	UCS	K.2.1
Ensign	Tari		DC_M5332	UCS	K.2.1
Ently	Hilary		DC_M6041	UCS	K.2.1
Epstein	Judy		DC_M6984	UCS	K.2.1
Erb	Jay		DC_M2181	UCS	K.2.1
Ereckson	Ezra		DC_M7282	UCS	K.2.1
Eremita	Linda		DC_M3574	UCS	K.2.1
Erickson	Carl J.		DC_M0200		K.3.14
Erickson	John		DC_M2942	UCS	K.2.1
Erickson	Kent		DC_M5971	UCS	K.2.1
Erickson	Rodney		DC_M6196	UCS	K.2.1
Erickson	Todd J.		DC_M4904	UCS	K.2.1
Ernsberger	Paul		DC_M1925	UCS	K.2.1
Erwin	Micah		DC_M7216	UCS	K.2.1
Espeland	Shirley		DC_M5013	UCS	K.2.1
Esposito	Barbara		DC_M4791	UCS	K.2.1
Esterle	Ann		DC_M5155	UCS	K.2.1
Esterwood	Woody		DC_E0212		K.3.3, K.3.7, K.3.11, K.3.12, K.3.15
Estes	Douglas		DC_M1434	UCS	K.2.1
Estes	John		DC_M5469	UCS	K.2.1
Estes	Rose		DC_M5964	UCS	K.2.1
Estrada	Jenny		DC_M0854	UCS	K.2.1
Estrella	Julia		DC_PHO0049		K.3.2, K.3.3, K.3.5, K.3.12, K.4
Estrella	Susan		DC_M2012	UCS	K.2.1
Etchison	Craig		DC_M0173		K.3.2, K.3.10, K.3.14
Etheridge	Ramona		DC_M1035	UCS	K.2.1
Etter	Hanya		DC_M4060	UCS	K.2.1
Etzkorn	Felicia		DC_M0210		K.3.1, K.3.14
Eudy	Elaine W.		DC_M0683		K.2.1
Euler	Renee		DC_M7228	UCS	K.2.1
Evans	Brenna		DC_M6025	UCS	K.2.1
Evans	Dinda		DC_E0253		K.2.2
Evans	Dinda		DC_M7654	UCS	K.2.1
Evans	Hazel		DC_E0338		K.2.2
Evans	James		DC_M2141	UCS	K.2.1
Evans	Jeffrey		DC_M0371		K.2.1
Evans	Jennie		DC_M3996	UCS	K.2.1
Evans	Jim		DC_M2394	UCS	K.2.1
Evans	Marcus		DC_M3256	UCS	K.2.1
Evans	Roxanna J.		DC_M3634	UCS	K.2.1
Eveleigh	John		DC_M0273	Menwith Hill Forum	K.2.2
Everdell	William R.		DC_M3838	UCS	K.2.1
Everett	Ashley		DC_M6153	UCS	K.2.1
Everett	Carter		DC_M7123	UCS	K.2.1
Everett	Miles		DC_PHO0006	Alliance for Democracy	K.3.2, K.3.3, K.3.5, K.3.10, K.3.11, K.3.13, K.3.15
Eversole	Scott Thomas		DC_M6190	UCS	K.2.1
Everton	Clyde		DC_M0325		K.2.1
Evilsizer	Susan		DC_M6804	UCS	K.2.1

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Evinger	Matthew		DC_M3549	UCS	K.2.1
Evoy	Cherryl		DC_M0442		K.2.1
Ewaskey	April		DC_M6218	UCS	K.2.1
Ewell	Kathryn		DC_M6090	UCS	K.2.1
Ewers	Suki		DC_M6498	UCS	K.2.1
Ewig	Patricia L.		DC_M0453		K.2.1
Ewing	Sarah		DC_E0132		K.3.1, K.3.14, K.3.3.
Exline	Brenda		DC_M1217	UCS	K.2.1
Eyer	Sharon		DC_M7443	UCS	K.2.1
Eyheralde	Carol		DC_M2534	UCS	K.2.1
Eyheralde	Margaret		DC_M3307	UCS	K.2.1
Ezzell	Grace		DC_M0285		K.2.1
Fabiano	Donald D.		DC_M7655	UCS	K.2.1
Fabre	Sherri		DC_M1240	UCS	K.2.1
Faes	Natalie		DC_M5337	UCS	K.2.1
Faes	Natalie		DC_M5338	UCS	K.2.1
Fahey	John		DC_M6757	UCS	K.2.1
Faich	Ron		DC_M4535	UCS	K.2.1
Fairbanks	Kathryn		DC_M0605		K.2.1
Fairchild	Stephanie M.		DC_M1230	UCS	K.2.1
Falconello	Kathy		DC_M2005	UCS	K.2.1
Falotico	Georgann		DC_M0990	UCS	K.2.1
Falzone	Richard		DC_M1451	UCS	K.2.1
Fancher	Keith		DC_M3254	UCS	K.2.1
Farber	Joy		DC_M7863		K.2.3
Faridi	Mohammad		DC_M4183	UCS	K.2.1
Farina	Carol		DC_M1820	UCS	K.2.1
Farlow	Erin		DC_M3709	UCS	K.2.1
Farmer	Brian		DC_M1347	UCS	K.2.1
Farmer	Cameron		DC_M3009	UCS	K.2.1
Farnan	Lisa		DC_M5289	UCS	K.2.1
Farnan	Michael		DC_M6549	UCS	K.2.1
Farnum	Jenn		DC_M0664		K.2.1
Farr	Harry A		DC_M6699	UCS	K.2.1
Farrell	Brandan		DC_M2321	UCS	K.2.1
Farrell	Catherine		DC_M3465	UCS	K.2.1
Farrington	Susanne		DC_M7697		K.2.1
Farris	Andrea		DC_M6690	UCS	K.2.1
Farris	Beth		DC_M2288	UCS	K.2.1
Farris	Dan		DC_M1611	UCS	K.2.1
Farritor	Robert		DC_M3558	UCS	K.2.1
Farry	Gwen		DC_E0244		K.3.3, K.3.7, K.3.12, K.3.15
Faruolo	Dawn		DC_M1093	UCS	K.2.1
Farwell	Beatrice		DC_M4090	UCS	K.2.1
Faszczewski	Joan		DC_M2832	UCS	K.2.1
Faulkingham	Laura		DC_M2410	UCS	K.2.1
Faunce	Jami		DC_M2368	UCS	K.2.1
Faust	Heather		DC_M0531		K.2.1
Favreau	Neuil		DC_E0281		K.2.2
Favret	Andrew		DC_M7205	UCS	K.2.1
Fearnley	Jackie		DC_E0437		K.3.1, K.3.13
Federman	Adele		DC_M5012	UCS	K.2.1
Federman	Ellen		DC_M2922	UCS	K.2.1
Feeley	Janet		DC_M2456	UCS	K.2.1
Fehribach	Robert		DC_M2355	UCS	K.2.1
Fehribach	Robert		DC_M2422	UCS	K.2.1
Fehribach	Robert		DC_M2423	UCS	K.2.1
Fehrmann	Susie		DC_M2930	UCS	K.2.1
Feichtinger	Dennis		DC_M4698	UCS	K.2.1

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Feiner	Kenneth		DC_M0368		K.2.1
Feinstein	Daniel		DC_M0431		K.2.1
Feist	Joann		DC_M2872	UCS	K.2.1
Feitler	Zanna		DC_M6916	UCS	K.2.1
Feldman	Brett		DC_M4676	UCS	K.2.1
Feldman	George		DC_E0334		K.3.2, K.3.3, K.3.15
Feldman	Isabel		DC_M3977	UCS	K.2.1
Feldman	Larraine		DC_M2707	UCS	K.2.1
Fellowes	Christine		DC_E0032		K.3.1, K.3.3, K.3.4, K.3.5, K.3.11, K.3.12, K.3.13
Fenske	Karl		DC_M7200	UCS	K.2.1
Fenster	Steven		DC_M4822	UCS	K.2.1
Feraldi	Nancy		DC_M1328	UCS	K.2.1
Ferdinand	Mary L.		DC_M0459		K.2.1
Ferguson	Joanne		DC_M6107	UCS	K.2.1
Ferguson	Stacy		DC_M1389	UCS	K.2.1
Fernandez	Elizabeth		DC_M4696	UCS	K.2.1
Ferraro	Mary		DC_M3070	UCS	K.2.1
Ferraro	Nancy H.		DC_M7575	UCS	K.2.1
Ferrell	Lee		DC_M2996	UCS	K.2.1
Ferrell	Lee		DC_M2997	UCS	K.2.1
Ferrero	Betty		DC_M5535	UCS	K.2.1
Ferrier	Andrew		DC_M6046	UCS	K.2.1
Ferrier	Malcolm D.		DC_M0509		K.2.1
Ferris	Keith		DC_M6466	UCS	K.2.1
Ferris	Marc		DC_M1201	UCS	K.2.1
Ferstl	Jean		DC_M7565	UCS	K.2.1
Fessant	Steve		DC_M4613	UCS	K.2.1
Festa	Robert		DC_M0970	UCS	K.2.1
Ficek	Kathy		DC_M2044	UCS	K.2.1
Fielding	Claudia		DC_M4016	UCS	K.2.1
Fieldman	Anita		DC_M6854	UCS	K.2.1
Fields	Leslie		DC_M6806	UCS	K.2.1
Fields	Mary		DC_M7003	UCS	K.2.1
Fields	William		DC_M3854	UCS	K.2.1
Fifield	Robert		DC_M6265	UCS	K.2.1
Figueiredo	Eva		DC_M2972	UCS	K.2.1
Figueroa	Gustavo		DC_M6333	UCS	K.2.1
Fike	Chris		DC_M7498	UCS	K.2.1
Filiaut	Paul		DC_E0219		K.2.3
Filipiak	Michael		DC_M7668	UCS	K.2.1
Filley	Charles		DC_M6921	UCS	K.2.1
Fina	Chris		DC_M4974	UCS	K.2.1
Finamore	Richard	Judith Finamore	DC_M6765	UCS	K.2.1
Finch	Kenneth		DC_M0995	UCS	K.2.1
Fingerhood	Shirley		DC_M4122	UCS	K.2.1
Fink	David		DC_M4874	UCS	K.2.1
Finkelstein	June		DC_M3882	UCS	K.2.1
Fink-Winter	Ruth		DC_M7801		K.2.3
Finlay	R		DC_M4691	UCS	K.2.1
Finley	Greg		DC_M0847	UCS	K.2.1
Finn	Micheal		DC_M2476	UCS	K.2.1
Finnefrock	Kathryn		DC_M2356	UCS	K.2.1
Finnie	Chris		DC_M7816		K.2.3
Finnigan	Dave		DC_M5921	UCS	K.2.1
Finnity	Margaret		DC_E0271		K.3.12
Fiore	Mark		DC_M6287	UCS	K.2.1
Fiore	Mark		DC_M6288	UCS	K.2.1
Fiore	Susan	Jim Fiore	DC_E0345		K.3.1, K.3.3, K.3.13

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Fiorentino	Doris		DC_M7680	UCS	K.2.1
Firestone	Anne		DC_M5668	UCS	K.2.1
Firth	Jen		DC_M5693	UCS	K.2.1
Fischer	Douglas		DC_M7046	UCS	K.2.1
Fischer	Quentin		DC_M5097	UCS	K.2.1
Fischer	Richard J.		DC_M7482	UCS	K.2.1
Fischler	Diane		DC_M3525	UCS	K.2.1
Fish	Ralph		DC_M2049	UCS	K.2.1
Fisher	Andrew		DC_M7929		K.2.3
Fisher	Bill		DC_E0256		K.3.2, K.3.3, K.3.10, K.3.11
Fisher	David		DC_M1120	UCS	K.2.1
Fisher	Dietrich		DC_E0408		K.3.2, K.3.4, K.3.5, K.3.6, K.3.7, K.3.10, K.3.11, K.3.12, K.3. 13
Fisher	Donald		DC_M0983	UCS	K.2.1
Fisher	Douglas		DC_M7849		K.2.1
Fisher	Eric		DC_M1015	UCS	K.2.1
Fisher	Larry		DC_M1908	UCS	K.2.1
Fisher	Leonard		DC_PHO0025	Physicians for Social Responsibility	K.3.1, K.3.10, K.3.15, K.4
Fisher	Owen		DC_M2526	UCS	K.2.1
Fishkin	Anne		DC_M0650		K.2.1
Fissinger	Kaye		DC_M5307	UCS	K.2.1
Fite	Michael		DC_M3856	UCS	K.2.1
Fitzgerald	Anna		DC_M4881	UCS	K.2.1
Fitzgerald	Diane S.		DC_M6522	UCS	K.2.1
Fitzgerald	Donna		DC_M1133	UCS	K.2.1
FitzGerld	Eunice		DC_E0299		K.3.12
Fitzgibbons	Matt		DC_M4961	UCS	K.2.1
Fitzke	Robert		DC_M1411	UCS	K.2.1
Fitzpatrick	Tom		DC_M4293	UCS	K.2.1
Fitzsimmons	Patricia		DC_M5831	UCS	K.2.1
Fiumara	Carol A.		DC_M4294	UCS	K.2.1
Fiumara	Carol A.		DC_M0415		K.2.1
Flackett	Gail		DC_M3884	UCS	K.2.1
Flagor	Robert M		DC_M2498	UCS	K.2.1
Flaherty	Brendan		DC_M2222	UCS	K.2.1
Flanagan	Mary		DC_M5291	UCS	K.2.1
Flanary	Kate		DC_M6234	UCS	K.2.1
Flasko	Jennifer		DC_M6876	UCS	K.2.1
Flaus	Brighton		DC_M5987	UCS	K.2.1
Fleck	Ayda Lucero		DC_M7618	UCS	K.2.1
Fleenor	Fitz		DC_M6445	UCS	K.2.1
Fleming	David		DC_M4514	UCS	K.2.1
Fleming	Elizabeth		DC_M4339	UCS	K.2.1
Fleming	Mark		DC_M6985	UCS	K.2.1
Fleming	Philip		DC_PHW0001	Lawyers Allicance for World Security	K.3.2, K.3.3, K.3.10, K.3.11, K.3.12, K.3.13, K.3.14, K.3.15, K.4
Fleming	Phillip		DC_P0011		K.3.9
Fleming	Rosemary		DC_M7284	UCS	K.2.1
Flemming	Edward W		DC_M1171	UCS	K.2.1
Flemming	Philip		DC_F0005	Lawyer Alliance for World Security	K.3.2, K.3.3, K.3.10, K.3.13, K.3.14, K.4
Flesch	Alma S.		DC_M2852	UCS	K.2.1
Fleshman	Joyce		DC_M6805	UCS	K.2.1
Flodin	Betty		DC_M7727		K.3.2, K.3.4, K.3.7, K.3.10
Flood	Beverly		DC_M6531	UCS	K.2.1
Flood	RaVani		DC_M7219	UCS	K.2.1

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Floran-Bernier	Elvira		DC_M7607	UCS	K.2.1
Flores	Tessa		DC_M5124	UCS	K.2.1
Flory	Rick		DC_M1544	UCS	K.2.1
Flounoy	Edward		DC_M3048	UCS	K.2.1
Flowers	Bobbie Dee		DC_M4386	UCS	K.2.1
Floyd	Kim		DC_M2083	UCS	K.2.1
Floyd	Virginia		DC_M0214		K.3.2, K.3.12, K.3.14
Fluor	Christine		DC_M2154	UCS	K.2.1
Flynn	Maxfield		DC_M0356		K.2.1
Fobes	Jeanne		DC_M1077	UCS	K.2.1
Foerstel	Melissa		DC_M1848	UCS	K.2.1
Foley	Elaina		DC_M5288	UCS	K.2.1
Foley	Jo		DC_M4925	UCS	K.2.1
Foley Jr	Robert l		DC_M2604	UCS	K.2.1
Follman	Micheal		DC_M3041	UCS	K.2.1
Followill	Peter		DC_M3843	UCS	K.2.1
Follykue	Amenounve		DC_M2265	UCS	K.2.1
Folsom	Susan		DC_M1349	UCS	K.2.1
Folsom	Susan		DC_M1450	UCS	K.2.1
Folta	Edith		DC_M4169	UCS	K.2.1
Fonda	Thomas		DC_M0175		K.2.1
Fonng	L P		DC_M7432	UCS	K.2.1
Foote	Greg		DC_M1821	UCS	K.2.1
Forbes	Jeanne		DC_M1080	UCS	K.2.1
Ford	Carol		DC_M3998	UCS	K.2.1
Ford	Kenneth		DC_M2745	UCS	K.2.1
Ford	Mary		DC_M0584		K.2.1
Ford	Michael C.		DC_M4756	UCS	K.2.1
Forer	Jo		DC_M5717	UCS	K.2.1
Forester	Helen		DC_M3973	UCS	K.2.1
Forester	Lorrie		DC_M0379		K.2.1
Forman	Carol		DC_M6615	UCS	K.2.1
Forman	Maureen		DC_M0230		K.2.1
Forney	Frank		DC_E0298		K.3.10, K.3.11, K.3.13
Forrest	Diana		DC_E0024		K.3.12
Forrest	Jennifer		DC_M0576		K.2.1
Forrest	Melinda		DC_M1131	UCS	K.2.1
Forrest	Robert		DC_M7710		K.2.1
Forsberg	Bob		DC_M2477	UCS	K.2.1
Forseth	Linnea		DC_M4420	UCS	K.2.1
Forsyth	Kelley		DC_M5651	UCS	K.2.1
Fortenberry	Patricia		DC_M7164	UCS	K.2.1
Fortin	Lily		DC_M6992	UCS	K.2.1
Fortney	John		DC_M3651	UCS	K.2.1
Fossard	James		DC_M0414		K.2.1
Foster	Cindy		DC_M1130	UCS	K.2.1
Foster	Cindy		DC_M7453	UCS	K.2.1
Foster	Daniel		DC_M4604	UCS	K.2.1
Foster	Jacqueline		DC_M5642	UCS	K.2.1
Foster	Jennifer		DC_M5974	UCS	K.2.1
Fotidzis	Tess		DC_M7497	UCS	K.2.1
Foulke	Robert		DC_M4638	UCS	K.2.1
Fouts	Vickie		DC_M7395	UCS	K.2.1
Fowle	Chris		DC_M1840	UCS	K.2.1
Fowler	Jason		DC_M3877	UCS	K.2.1
Fowler	Linda		DC_M3325	UCS	K.2.1
Fowler	Pat		DC_M0251		K.2.1
Fox	Diana		DC_M3422	UCS	K.2.1
Fox	Eve		DC_M7144	UCS	K.2.1

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Fox	Marvin K		DC_M7027	UCS	K.2.1
Fox-Kemper	Baylor		DC_M2244	UCS	K.2.1
Foxworthy	Bruce L.		DC_M4561	UCS	K.2.1
Frame	Diana		DC_M6707	UCS	K.2.1
Frame	Karen		DC_M0957	UCS	K.2.1
Frame	Laura		DC_M6319	UCS	K.2.1
Francine	Jon		DC_E0431		K.4
Francis	Evan		DC_M6835	UCS	K.2.1
Francisco	Linda		DC_M4509	UCS	K.2.1
Francois	Anne-Lise		DC_M4337	UCS	K.2.1
Frank	Harritette		DC_M5271	UCS	K.2.1
Frank	Lee		DC_M1631	UCS	K.2.1
Frankel	Anne		DC_M5171	UCS	K.2.1
Frankel	Madeline		DC_M0560		K.2.1
Franklin	Douglas		DC_M0180		K.2.1
Franklin	Mary		DC_M2202	UCS	K.2.1
Franklin	Sarah		DC_M7083	UCS	K.2.1
Frantz	Don		DC_M1473	UCS	K.2.1
Frantz	Glenn		DC_M0627		K.2.1
Frantz	Glenn		DC_M4053	UCS	K.2.1
Frantz	Mary		DC_M6920	UCS	K.2.1
Frappier	Amy		DC_M6083	UCS	K.2.1
Fraser	William		DC_M2203	UCS	K.2.1
Fratoni	Mark		DC_M1235	UCS	K.2.1
Frazier	Eileen		DC_M3479	UCS	K.2.1
Frazier	Sharon		DC_M2714	UCS	K.2.1
Freamon	Dierdre		DC_M0745		K.2.1
Freberg	Deborah L.		DC_M6675	UCS	K.2.1
Freda	Gretchen		DC_M2474	UCS	K.2.1
Frederick	Gail		DC_M4073	UCS	K.2.1
Fredericks	Misha		DC_M4802	UCS	K.2.1
Fredrick	Jessica		DC_M3663	UCS	K.2.1
Freedman	Mike		DC_M3472	UCS	K.2.1
Freedom	Nancy		DC_M6345	UCS	K.2.1
Freel	Dorothy		DC_M1417	UCS	K.2.1
Freeman	Kimberly		DC_M1543	UCS	K.2.1
Freeman	Lena		DC_M3697	UCS	K.2.1
Freeman	Lena		DC_M4753	UCS	K.2.1
Freeman	Lena		DC_M6033	UCS	K.2.1
Freemole	Maynard		DC_M4572	UCS	K.2.1
Freese	Catherine		DC_E0060		K.3.7
Freitas	Col. Robert		DC_M1708	UCS	K.2.1
Freitas	Julene		DC_M4648	UCS	K.2.1
French	Bryan		DC_M6411	UCS	K.2.1
French	Effie		DC_M5536	UCS	K.2.1
French	Jacque		DC_M3045	UCS	K.2.1
French	Robert		DC_M3365	UCS	K.2.1
Frewin	Terri L		DC_M2573	UCS	K.2.1
Fried	Barbara		DC_M5497	UCS	K.2.1
Friedbauer	John		DC_M6639	UCS	K.2.1
Friedberg	Zoe		DC_M4099	UCS	K.2.1
Friedman	Benno		DC_M6174	UCS	K.2.1
Friedman	Elaine		DC_M2564	UCS	K.2.1
Friedman	Jody		DC_M7665	UCS	K.2.1
Friedman	Judi		DC_M0252		K.3.14
Friedman	Martin		DC_M7245	UCS	K.2.1
Friedman	Phyllis		DC_M7109	UCS	K.2.1
Friedman	Ruth H		DC_M2316	UCS	K.2.1
Friend	Eddie		DC_M2879	UCS	K.2.1

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Friendly	Frog		DC_M3105	UCS	K.2.1
Friesen	Debbie		DC_M1610	UCS	K.2.1
Friese-Staddler	Darlene		DC_M6890	UCS	K.2.1
Frigerio	Ashley		DC_M5400	UCS	K.2.1
Frisch	Matthew		DC_M4419	UCS	K.2.1
Frisch	Matthew		DC_M4426	UCS	K.2.1
Frisinger	Ryan		DC_M1234	UCS	K.2.1
Frith	Rachel		DC_M2762	UCS	K.2.1
Fritsche	A.		DC_M1785	UCS	K.2.1
Fritz	David		DC_M4732	UCS	K.2.1
Fritz	Stacey A.		DC_M7306	UCS	K.2.1
Froemming	Mary		DC_M1774	UCS	K.2.1
Frohnsdorff	Geoffrey		DC_M7695		K.3.1, K.3.4, K.3.11, K.3.13, K.3.14, K.3.15
Fromson	David		DC_M3612	UCS	K.2.1
Frost	Diana		DC_M6832	UCS	K.2.1
Frost	Jan		DC_M6184	UCS	K.2.1
Frumkin	Robert		DC_M0026	FAAAS and UCS	K.3.2, K.3.3, K.3.4, K.3.5, K.3.15
Fry	Brian		DC_E0282	Justice Coordinator, Congregation of St. Joseph	K.3.5, K.3.7
Fryburg	Stephen S.		DC_M3858	UCS	K.2.1
Fuccile	Madeline		DC_M0100		K.2.1
Fuchs	Ester		DC_M3770	UCS	K.2.1
Fudeman	Will		DC_E0211		K.3.2, K.3.3, K.3.4, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Fuess	Sam		DC_M5349	UCS	K.2.1
Fuhrman	Jed		DC_M0436		K.2.1
Fujiyoshi	Ronald		DC_M2936	UCS	K.2.1
Fujiyoshi	Ronald		DC_PHO0050	U.S. Japan Committee for Racial Justice	K.3.1, K.3.2, K.3.3, K.3.5, K.3.12, K.3.15, K.4
Fuller	Linda		DC_M2327	UCS	K.2.1
Fuller	Richard		DC_E0151		K.3.14
Fuller	Roy		DC_M4004	UCS	K.2.1
Fullerton	Dustyn		DC_M2036	UCS	K.2.1
Fullmer	Deb		DC_M0283		K.2.1
Fulmer-Scales	Karen		DC_M4800	UCS	K.2.1
Fulton	Richard		DC_M1212	UCS	K.2.1
Fulton	Tom		DC_M4899	UCS	K.2.1
Funk	Diane		DC_M0561		K.2.1
Furgurson	Neal		DC_M2168	UCS	K.2.1
Furlong	Randall		DC_M0486		K.2.1
Furmanski	Marie		DC_M7736		K.2.1
Furnish	Shearle		DC_M2402	UCS	K.2.1
Furr	Steven		DC_M4027	UCS	K.2.1
Fussner	Mary S.		DC_M5314	UCS	K.2.1
Futrell	Sherrill		DC_M7674	UCS	K.2.1
G	Ali		DC_M1790	UCS	K.2.1
G	Cheryl		DC_M6464	UCS	K.2.1
G	Ruth		DC_M2990	UCS	K.2.1
G.H.	Sara		DC_M3272	UCS	K.2.1
Gabe	Tara		DC_M3787	UCS	K.2.1
Gabey	Ruth		DC_E0041		K.3.7, K.3.15
Gaborow	Barbara Jane		DC_M0732		K.2.1
Gabriel	Alannah		DC_M5539	UCS	K.2.1
Gabriel	Kay		DC_M7786		K.2.1
Gabrieli	Diego		DC_M1147	UCS	K.2.1

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Gac	I.		DC_M4501	UCS	K.2.1
Gac	Wayne		DC_M6882	UCS	K.2.1
Gaddis	Mary Lou		DC_M5115	UCS	K.2.1
Gadoury	Kathryn		DC_M4707	UCS	K.2.1
Gaede	Marnie		DC_M5170	UCS	K.2.1
Gaffney	Patrick		DC_M4575	UCS	K.2.1
Gafford	Georgette		DC_M2488	UCS	K.2.1
Gage	Cathy		DC_M2662	UCS	K.2.1
Gagnon	Bruce		DC_M0235	Global Network Against Weapons and Nuclear Power in Space	K.2.2
Gaines	Richard		DC_M5481	UCS	K.2.1
Gaither	John		DC_M7834		K.2.1
Galbreath	Marcy		DC_M1684	UCS	K.2.1
Galdamez	Alicia		DC_M3730	UCS	K.2.1
Galieti	Ron		DC_M7331	UCS	K.2.1
Gallagher	Edward		DC_M6859	UCS	K.2.1
Gallagher	James		DC_M0101		K.3.10, K.3.13, K.3.14
Gallatin	Mary		DC_M4152	UCS	K.2.1
Gallimore	Gregg		DC_M7685	UCS	K.2.1
Gallo	Patti		DC_M5910	UCS	K.2.1
Gallup	David		DC_M2352	UCS	K.2.1
Galton	Christopher		DC_M3849	UCS	K.2.1
Galuska	Michael		DC_M1555	UCS	K.2.1
Galvez	Jose		DC_M3197	UCS	K.2.1
Galyardt	Ben		DC_M5655	UCS	K.2.1
Gambino	Jill		DC_M1792	UCS	K.2.1
Gamble	Fairlee		DC_M6103	UCS	K.2.1
Gambonini	Bette		DC_E0189		K.2.2
Gamrath	Dave		DC_M1242	UCS	K.2.1
Gangi	Lisa		DC_M4238	UCS	K.2.1
Gant	Heather		DC_M4455	UCS	K.2.1
Ganter	Paul		DC_M6322	UCS	K.2.1
Gap	Michelle		DC_M1816	UCS	K.2.1
Garber	Paul		DC_M6377	UCS	K.2.1
Garber	Sandra		DC_M0797	UCS	K.2.1
Garcia	Alfred		DC_M5257	UCS	K.2.1
Garcia	Brenda		DC_M4531	UCS	K.2.1
Garcia	Bridgette		DC_M1716	UCS	K.2.1
Garcia	Camilo N.		DC_M5297	UCS	K.2.1
Garcia	Eliana		DC_M6732	UCS	K.2.1
Garcia	Greg		DC_PHO0039	Alaskans for Peace and Justice, No Nuke North	K.3.2, K.3.3, K.3.4, K.3.10, K.3.11, K.3.12, K.3.13, K.4
Garcia	Jeffery A		DC_M3199	UCS	K.2.1
Garcia	Kevin		DC_M3581	UCS	K.2.1
Garcia	Paula		DC_M4383	UCS	K.2.1
Garcia	Sarah		DC_M4538	UCS	K.2.1
Gardener	Natalia Lee		DC_M4722	UCS	K.2.1
Gardner	B. Kay		DC_M3119	UCS	K.2.1
Gardner	Barbara		DC_M1522	UCS	K.2.1
Gardner	Barbara		DC_M1521	UCS	K.2.1
Gardner	Elliott		DC_M2780	UCS	K.2.1
Gardner	Linda		DC_M4830	UCS	K.2.1
Gardner	Steve		DC_M3049	UCS	K.2.1
Garen	David		DC_M1233	UCS	K.2.1
Gargiulo	John		DC_M7145	UCS	K.2.1
Garland	Ruth		DC_M6309	UCS	K.2.1

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Garlick	Tena		DC_M4362	UCS	K.2.1
Garmon	Jeff		DC_M6194	UCS	K.2.1
Garner	Lee		DC_M5748	UCS	K.2.1
Garner	Phil		DC_M5086	UCS	K.2.1
Garnes	Rochelle		DC_M0518		K.2.1
Garove	Alex		DC_M4505	UCS	K.2.1
Garrett	M.L.		DC_M5253	UCS	K.2.1
Gartin	Courtney		DC_M5014	UCS	K.2.1
Gartner	Robert		DC_M3650	UCS	K.2.1
Garton	Jan		DC_M7891		K.2.1
Garvey	Lydia		DC_M0221		K.3.1, K.3.2, K.3.3, K.3.5, K.3.13, K.3.14, K.3.15
Garvey	Lydia		DC_M6496	UCS	K.2.1
Garwin	Edward		DC_M0405		K.2.1
Gary	Kurt		DC_M4042	UCS	K.2.1
Garze	Cecilia		DC_M6579	UCS	K.2.1
Gaskins	Mary Anne		DC_M0716		K.2.1
Gates	Dorothy		DC_M3764	UCS	K.2.1
Gathing	Nancy		DC_M3706	UCS	K.2.1
Gathing	Nancy		DC_M4343	UCS	K.2.1
Gatzke	Rhonda		DC_M4920	UCS	K.2.1
Gaulin	Cynthia		DC_M6978	UCS	K.2.1
Gault	Ted		DC_M3714	UCS	K.2.1
Gawne	Cindy		DC_M6150	UCS	K.2.1
Gazorn	Gwen		DC_E0412		K.3.1, K.3.2, K.3.6, K.3.7, K.3.10, K.3.11, K.3.15
Geary	B.		DC_M6243	UCS	K.2.1
Gebhardt	Matt		DC_M4271	UCS	K.2.1
Gebhardt	Walter		DC_M4641	UCS	K.2.1
Gebhart	Gerald		DC_M6867	UCS	K.2.1
Geczy	Renee		DC_M4963	UCS	K.2.1
Geear	Jim		DC_M3266	UCS	K.2.1
Gegner	Jack		DC_M6665	UCS	K.2.1
Geisel	Julie		DC_M2165	UCS	K.2.1
Geisert	Matthew		DC_M1964	UCS	K.2.1
Geisler	Dorothy		DC_M0218		K.3.2, K.3.10, K.3.14
Geissinger	Annie		DC_M1588	UCS	K.2.1
Geissler	Jean		DC_M4410	UCS	K.2.1
Geist	Barbara		DC_M4161	UCS	K.2.1
Geist	Linda		DC_M6590	UCS	K.2.1
Geitner	Charles		DC_M5173	UCS	K.2.1
Gelover	Jerome		DC_M6776	UCS	K.2.1
Genthner	Sara Hoffman		DC_M5610	UCS	K.2.1
Gentile	Frank		DC_M4326	UCS	K.2.1
Gentry	Mark		DC_M0585		K.2.1
George	Carolyn		DC_M2119	UCS	K.2.1
George	Christy		DC_M3544	UCS	K.2.1
George	Edward		DC_M4956	UCS	K.2.1
George	Helga		DC_M3829	UCS	K.2.1
George	Joni		DC_M7105	UCS	K.2.1
Georgeson	Christa		DC_M1876	UCS	K.2.1
Georgiades	Vanessa		DC_M1394	UCS	K.2.1
Georgiou	Christine		DC_M7008	UCS	K.2.1
Gepp	Sara		DC_M2605	UCS	K.2.1
Geraets	Mary		DC_E0149		K.2.2
Geraw	Heather		DC_M5894	UCS	K.2.1
Gerber	Jerry		DC_M5449	UCS	K.2.1
Gerber	John		DC_M5888	UCS	K.2.1
Gerlach	Trudy		DC_M6367	UCS	K.2.1

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Germanus	Andrea		DC_M5391	UCS	K.2.1
Gerrity	Sharon		DC_M1285	UCS	K.2.1
Gerster	Anne		DC_M1409	UCS	K.2.1
Gerster	Anne		DC_M5183	UCS	K.2.1
Gerster	E. Alexander		DC_M2924	UCS	K.2.1
Gervits	Kate		DC_M1657	UCS	K.2.1
Gfddrh	Hesss		DC_M1852	UCS	K.2.1
Gholson	Christien		DC_E0249		K.2.2
Giampa	Luciano		DC_M1796	UCS	K.2.1
Giantomasi	David		DC_M4548	UCS	K.2.1
Giarrizzo	Andrew		DC_M7799		K.2.1
Gibbions	John		DC_E0432		K.3.9
Gibbon	Roy		DC_M2777	UCS	K.2.1
Gibbons	Brian T		DC_M3096	UCS	K.2.1
Gibbons	Eva		DC_M0490		K.2.1
Gibbons	Eva		DC_M2842	UCS	K.2.1
Gibbons	Eva		DC_M3454	UCS	K.2.1
Gibbons	Jeanne		DC_M1311	UCS	K.2.1
Gibbs	Kathleen		DC_M2191	UCS	K.2.1
Gibbs	William		DC_M2909	UCS	K.2.1
Gibbs-Halm	Debbie		DC_M7062	UCS	K.2.1
Gibson	Carol		DC_M5825	UCS	K.2.1
Gibson	Janice		DC_M1436	UCS	K.2.1
Gibson	Jess		DC_M4398	UCS	K.2.1
Gibson	Robert		DC_M6774	UCS	K.2.1
Gicking	Barbara		DC_M3248	UCS	K.2.1
Giebink	Nancy		DC_M7546	UCS	K.2.1
Gierlach	Marian Baker		DC_M3210	UCS	K.2.1
Giesselbach	Ann		DC_M3459	UCS	K.2.1
Gifford	John	Diane Gifford	DC_M5618	UCS	K.2.1
Gilbert	Gail		DC_M0043		K.2.1
Gilbert	Heidi		DC_M0465		K.2.1
Gilbert	Judith		DC_M6661	UCS	K.2.1
Gilbert	Michael		DC_M5104	UCS	K.2.1
Gilbert	Phyllis		DC_E0405	Peace Action-Delaware Valley	K.3.1, K.3.3, K.3.4, K.3.6, K.3.7, K.3.11, K.3.12, K.3.15
Gilbert	Rachel		DC_M5169	UCS	K.2.1
Gilbert	Robert		DC_M1144	UCS	K.2.1
Gilbert	Robert	Patricia Gilbert	DC_M4784	UCS	K.2.1
Gilchrist	Siobhan		DC_M6418	UCS	K.2.1
Giles	Gail		DC_M6500	UCS	K.2.1
Giles	Jazer		DC_M2320	UCS	K.2.1
Giles	Kathy		DC_M6079	UCS	K.2.1
Giles	Marlene		DC_M2397	UCS	K.2.1
Gilgun	Michael		DC_M6100	UCS	K.2.1
Gill	Michael		DC_M1324	UCS	K.2.1
Gill	Sherrie		DC_M0432		K.2.1
Gillard	Richard		DC_M2125	UCS	K.2.1
Gillen	Christine		DC_M3448	UCS	K.2.1
Gillett	Julia Marie		DC_M4105	UCS	K.2.1
Gillis	Greg		DC_M6102	UCS	K.2.1
Gillman	Miki		DC_M5329	UCS	K.2.1
Gilman	Richard		DC_M6545	UCS	K.2.1
Gilmer	Peggy		DC_M1911	UCS	K.2.1
Ginestra	Margaret		DC_M0171		K.2.1
Giniewicz	Debbie		DC_M2848	UCS	K.2.1
Ginsburg	Michael		DC_M6286	UCS	K.2.1
Gioia	Benjamin		DC_M1702	UCS	K.2.1
Gioia	Benjamin		DC_M5425	UCS	K.2.1

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Gioia	Sarah		DC_M6988	UCS	K.2.1
Giraldo	Janiel		DC_M1507	UCS	K.2.1
Girffin	Kimberly		DC_M1511	UCS	K.2.1
Girjalva	Michael		DC_M0917	UCS	K.2.1
Gisick	Rodney		DC_M3904	UCS	K.2.1
Giuliani	Rachelle		DC_M7873		K.2.1
Gjessing	Helen		DC_M0335		K.2.1
Glamser	Peter		DC_M2285	UCS	K.2.1
Glanc	Ross		DC_M0896	UCS	K.2.1
Glanz	Filson		DC_E0355		K.3.2, K.3.3, K.3.6, K.3.11, K.3.12, K.3.15, K.4
Glasner	Lynne		DC_M7552	UCS	K.2.1
Glauser	Charlotte		DC_M3563	UCS	K.2.1
Glavina	Sonja		DC_M7010	UCS	K.2.1
Glavina	Vesna		DC_M7011	UCS	K.2.1
Gleason	Ann		DC_M5194	UCS	K.2.1
Gleason	Ann		DC_M5316	UCS	K.2.1
Gleason	Jessica		DC_M3064	UCS	K.2.1
Gleason	Richard		DC_M3060	UCS	K.2.1
Gleckel	Garry		DC_M6396	UCS	K.2.1
Glenn	Martha		DC_M3573	UCS	K.2.1
Glenn	Sarah		DC_M4803	UCS	K.2.1
Glenn	T		DC_M3408	UCS	K.2.1
Glick	Marion		DC_M3631	UCS	K.2.1
Glick	Mike		DC_M5918	UCS	K.2.1
Glimpse	Anne		DC_M0610		K.2.1
Glimpse	Anne		DC_M0624		K.2.1
Glissendorf	William		DC_M3968	UCS	K.2.1
Gliva	Dave		DC_M0718		K.2.1
Gliva	Stephen		DC_M0544		K.2.1
Glor	Poppy		DC_M1487	UCS	K.2.1
Glover	Emma		DC_PHO0056		K.3.2, K.3.11
Gluckman	Joan		DC_M4320	UCS	K.2.1
Glusker	Stephen		DC_M5078	UCS	K.2.1
Gluskini	Jason		DC_M0885	UCS	K.2.1
Gnezda	Anthony J		DC_M3292	UCS	K.2.1
Go	Jimmy		DC_M5036	UCS	K.2.1
Goding	Larry		DC_M4074	UCS	K.2.1
Godwin	Lara		DC_M4720	UCS	K.2.1
Godwin	Sherryanne		DC_M2913	UCS	K.2.1
Goebel	Jane		DC_M1509	UCS	K.2.1
Goebel	Katherine		DC_M0815	UCS	K.2.1
Goetinck	Jean		DC_M3075	UCS	K.2.1
Goff	Bruce		DC_M4702	UCS	K.2.1
Goff	Redux		DC_M5018	UCS	K.2.1
Gofman	Sheryl		DC_M3990	UCS	K.2.1
Goheen	Tamara		DC_M7587	UCS	K.2.1
Golban	Yasaman		DC_M0808	UCS	K.2.1
Goldberg	Freeda		DC_M5026	UCS	K.2.1
Goldberg	Ken		DC_M0948	UCS	K.2.1
Golden	Connie		DC_M0751		K.2.1
Golden	Jerry		DC_M4274	UCS	K.2.1
Goldfeder	Stanley		DC_M5198	UCS	K.2.1
Goldfeld	Anne		DC_M0723		K.2.1
Goldfinch	Albert		DC_M6926	UCS	K.2.1
Goldner	Ronald		DC_M0548		K.2.1
Goldsmith	Jane		DC_M5041	UCS	K.2.1
Goldstein	Carol Ann		DC_M6217	UCS	K.2.1
Goldstein	David		DC_M2002	UCS	K.2.1

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Goldstein	Gary		DC_M5304	UCS	K.2.1
Goldstein	Karl		DC_M7640	UCS	K.2.1
Goldstick	Corrine		DC_PHO0054		K.3.1
Goldthwaite	Robert		DC_M5212	UCS	K.2.1
Goldwaite	Lerea		DC_M5243	UCS	K.2.1
Golembeski	Ed		DC_M6849	UCS	K.2.1
Golis	Dale		DC_M2684	UCS	K.2.1
Golodik	Tom		DC_M2241	UCS	K.2.1
Golove	William		DC_M7490	UCS	K.2.1
Gols	Lorie		DC_M6572	UCS	K.2.1
Gomer	Kimberley		DC_M2279	UCS	K.2.1
Gomez	Angela		DC_M6605	UCS	K.2.1
Gomez	Carlos		DC_M2096	UCS	K.2.1
Gomez	Eleanor		DC_M4738	UCS	K.2.1
Gomez	Lenora		DC_M6731	UCS	K.2.1
Gomez	Maria L.		DC_M1519	UCS	K.2.1
Gomsi	Nellie G.		DC_M4645	UCS	K.2.1
Gonci	David		DC_M0898	UCS	K.2.1
Gonyo	Linda J.		DC_M4524	UCS	K.2.1
Gonzales	Paula		DC_M2747	UCS	K.2.1
Gonzalez	Concpecion		DC_M1491	UCS	K.2.1
Gonzalez	Lisa		DC_M2215	UCS	K.2.1
Gonzalez	Lisa		DC_M6524	UCS	K.2.1
Gonzalez	Rob		DC_M1257	UCS	K.2.1
Gonzalez	Stephen		DC_PHO0028		K.3.13, K.3.15
Goode	Deborah		DC_M3690	UCS	K.2.1
Goodell	Adele		DC_M3635	UCS	K.2.1
Goodell	Adele		DC_M3636	UCS	K.2.1
Goodell	Adele		DC_M4900	UCS	K.2.1
Goodin	Ben		DC_M5204	UCS	K.2.1
Goodmaker	Greg		DC_M7422	UCS	K.2.1
Goodman	E.		DC_M4785	UCS	K.2.1
Goodman	Ellen		DC_M3878	UCS	K.2.1
Goodman	Jerry		DC_M1146	UCS	K.2.1
Goodman	Jerry		DC_M7743		K.2.3
Goodman	Jodi		DC_M3524	UCS	K.2.1
Goodman	Linda		DC_M0136		K.2.1
Goodman	Shelley		DC_M3501	UCS	K.2.1
Goodman	Sidney		DC_E0052		K.3.2, K.3.4, K.3.10, K.3.13
Goodman	Sidney J.		DC_M1357	UCS	K.2.1
Goodrich	John H.		DC_M1157	UCS	K.2.1
Goodwin	A.		DC_M7930		K.2.1
Goolsby	Virginia		DC_M2253	UCS	K.2.1
Goosey	Doug		DC_M5486	UCS	K.2.1
Gorby	Heather		DC_M2379	UCS	K.2.1
Gordley	D. Janet		DC_M6725	UCS	K.2.1
Gordon	Bradley		DC_M0153		K.2.1
Gordon	John		DC_M4890	UCS	K.2.1
Goring	Brent		DC_M2701	UCS	K.2.1
Gorman	Brian		DC_M5671	UCS	K.2.1
Gorman	Kathleen		DC_E0238		K.3.3, K.3.4, K.3.5, K.3.12
Gormann	Paul		DC_M6698	UCS	K.2.1
Gorringe	Richard		DC_M5622	UCS	K.2.1
Gorton	Kevin		DC_M4560	UCS	K.2.1
Gorzelsky	Gwen		DC_M1765	UCS	K.2.1
Goth	George		DC_M0027		K.3.2, K.3.7, K.3.10
Gottemoeller	Madeline		DC_M7373	UCS	K.2.1
Gottlieb	Seymour		DC_M0563		K.2.1
Gottschalk	Lyn		DC_M1965	UCS	K.2.1

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Gould	Laura		DC_E0155		K.3.1, K.3.7
Gould	Robert		DC_E0424	PSR-former national president, current SF president	K.3.2, K.3.3, K.3.4, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Govedare	Joan		DC_M0181		K.3.2, K.3.3, K.3.4, K.3.5, K.3.7, K.3.10, K.3.11, K.3.13, K.3.14, K.3.15
Govedare	Joan		DC_M5345	UCS	K.2.1
Gover	Mary		DC_M5914	UCS	K.2.1
Governale	John		DC_M3411	UCS	K.2.1
Goynes	Beverlee		DC_M3995	UCS	K.2.1
Grabert	Christian		DC_M7392	UCS	K.2.1
Grace	Amy		DC_M7645	UCS	K.2.1
Grace	Kerri		DC_M0795	UCS	K.2.1
Grace	R. Mark		DC_M3609	UCS	K.2.1
Gradler	Patricia		DC_M1118	UCS	K.2.1
Graf	Kenneth		DC_M4916	UCS	K.2.1
Graham	Charlie		DC_M6408	UCS	K.2.1
Graham	Helen		DC_M0014		K.2.2
Graham	Holly		DC_E0069		K.2.2
Graham	Kenneth		DC_M4792	UCS	K.2.1
Graham	Kimberley		DC_M7119	UCS	K.2.1
Graham	Susan		DC_M4980	UCS	K.2.1
Grainer	Aimee		DC_M0949	UCS	K.2.1
Granat	Gary		DC_M3103	UCS	K.2.1
Granick	Lawrence		DC_M1159	UCS	K.2.1
Grant	Bette		DC_M5462	UCS	K.2.1
Grant	Gordon		DC_M4559	UCS	K.2.1
Grant	John		DC_E0247		K.3.1, K.3.2, K.3.10, K.3.15
Grant	Michael		DC_M0073		K.2.1
Grant	Miles		DC_M2970	UCS	K.2.1
Grasmeyer	Joel		DC_M5726	UCS	K.2.1
Grassia	Arianna		DC_M0366		K.2.1
Grassia	Linda		DC_M2139	UCS	K.2.1
Graue	Walter		DC_M6614	UCS	K.2.1
Grauer	Steven		DC_M7190	UCS	K.2.1
Grauman	Hilda		DC_E0117		K.2.3
Gravely	Brittany		DC_M7781		K.3.2, K.3.3, K.3.4, K.3.5, K.3.7, K.3.10, K.3.11, K.3.13, K.3.15
Graves	Mary		DC_M5721	UCS	K.2.1
Gray	Allan		DC_M6223	UCS	K.2.1
Gray	Carol		DC_M1486	UCS	K.2.1
Gray	Corinda		DC_M3744	UCS	K.2.1
Gray	Debbie		DC_E0120		K.2.3
Gray	Erica		DC_M3101	UCS	K.2.1
Gray	Katherine		DC_M7485	UCS	K.2.1
Gray	Lynne		DC_M0154		K.2.1
Gray	Mary		DC_M2128	UCS	K.2.1
Gray	Sumner		DC_E0029		K.3.1, K.3.2, K.3.7
Gray-See	Lisa		DC_M6677	UCS	K.2.1
Greaney	Dan		DC_M2757	UCS	K.2.1
Greco	Claudia		DC_M4750	UCS	K.2.1
Greek	Ragnhild		DC_E0239		K.2.2
Greemann	Ellen		DC_M7271	UCS	K.2.1
Green	Alan		DC_M0899	UCS	K.2.1
Green	Barbara		DC_M5862	UCS	K.2.1
Green	Barbara L		DC_M0489		K.2.1
Green	Ben		DC_M0556		K.2.1

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Green	Heather Meeker		DC_M7651	UCS	K.2.1
Green	J.M.		DC_M7410	UCS	K.2.1
Green	Joel		DC_M7837		K.2.1
Green	Judith	James Kurtz	DC_M7746		K.3.2, K.3.4, K.3.5, K.3.7, K.3.10, K.3.11, K.3.13, K.3.14, K.3.15
Green	Judith	James Kurtz	DC_M7747		K.3.2, K.3.4, K.3.5, K.3.7, K.3.10, K.3.11, K.3.13, K.3.14, K.3.15
Green	Juli		DC_E0259	Loyola Society for Civil Engagement	K.3.3, K.3.13
Green	Lance		DC_M4170	UCS	K.2.1
Green	Mary		DC_M2339	UCS	K.2.1
Green	Michael		DC_E0076	Professor of Chemistry City College	K.3.7, K.3.10, K.3.14
Green	Mike		DC_M3185	UCS	K.2.1
Green	Pamela		DC_M1252	UCS	K.2.1
Green	Steve		DC_M4876	UCS	K.2.1
Green	Vanessa		DC_M0587		K.2.1
Green	Theresa		DC_M6434	UCS	K.2.1
Greenberg	Jill		DC_M3528	UCS	K.2.1
Greenberrg	Ulla		DC_M6723	UCS	K.2.1
Greene	Eileen		DC_M7844		K.2.1
Greene	Linda		DC_M1009	UCS	K.2.1
Greene	Minna		DC_M3286	UCS	K.2.1
Greene	Tracia		DC_M6664	UCS	K.2.1
Greenfield	Dawn		DC_E0328		K.2.2
Greenfield	Dawn		DC_M0254		K.2.2
Greenfield	Mark		DC_M5042	UCS	K.2.1
Greenfield	Veronica		DC_E0356		K.2.2
Greensfelder	Roger		DC_M3061	UCS	K.2.1
Greensfelder	Roger		DC_M3098	UCS	K.2.1
Greenspan	Emily R.		DC_M6726	UCS	K.2.1
Greenstein	Michele		DC_M3328	UCS	K.2.1
Greenwald	Virginia		DC_M1691	UCS	K.2.1
Greenway	Lumina		DC_M6564	UCS	K.2.1
Greenwell	Donna		DC_M2821	UCS	K.2.1
Greenwell	Jack		DC_E0352		K.2.2
Greenwell	Neil		DC_E0386		K.3.2, K.3.3, K.3.6, K.3.7, K.3.11, K.3.12, K.3.15
Greenwood	Ellen		DC_M7391	UCS	K.2.1
Gregg	Linda		DC_M0396		K.2.1
Gregory	Carol T		DC_M2925	UCS	K.2.1
Gregory	Marc		DC_M2723	UCS	K.2.1
Gregory	MaryAnn		DC_M2515	UCS	K.2.1
Gregory	William J.		DC_M5393	UCS	K.2.1
Gregson	Rodney		DC_M6962	UCS	K.2.1
Greiner	Sarah		DC_M5263	UCS	K.2.1
Greiner	Tony		DC_M6600	UCS	K.2.1
Gresko	Michael		DC_M3900	UCS	K.2.1
Gress	Archie		DC_M1025	UCS	K.2.1
Greyraven	Ruth		DC_M7772		K.2.1
Grib	Dawn		DC_M5590	UCS	K.2.1
Gries	Susan		DC_M1990	UCS	K.2.1
Griffin	Colton		DC_M4492	UCS	K.2.1
Griffin	Colton		DC_M6271	UCS	K.2.1
Griffin	Colton		DC_M7292	UCS	K.2.1
Griffin	K		DC_M6512	UCS	K.2.1

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Griffin	Virginia		DC_M7867		K.2.3
Griffith	Ellen B.		DC_M3350	UCS	K.2.1
Griffith	Paul		DC_M7948		K.2.1
Griffith	Robert		DC_M4037	UCS	K.2.1
Griffith	Ryan		DC_M7273	UCS	K.2.1
Griffith	Margaret		DC_M4858	UCS	K.2.1
Griffiths	Susan		DC_M4635	UCS	K.2.1
Griffiths	Susan Alice		DC_M2858	UCS	K.2.1
Grigaltchik	Veronica		DC_M5500	UCS	K.2.1
Griggs	Linda		DC_M3826	UCS	K.2.1
Grillo	John		DC_M7915		K.2.1
Grimes	Elizabeth		DC_M4972	UCS	K.2.1
Grimesey	David		DC_M5476	UCS	K.2.1
Grimm	Cody		DC_M5912	UCS	K.2.1
Grimm	Cody		DC_M5913	UCS	K.2.1
Grimm	Sharon		DC_M6740	UCS	K.2.1
Grinstein	Geoffrey		DC_M7919		K.2.3
Grisel	Judy		DC_M7580	UCS	K.2.1
Griswold	Lyman W.		DC_M1692	UCS	K.2.1
Griswold	Lyman W.		DC_M1694	UCS	K.2.1
Griswold	Lyman W.		DC_M5456	UCS	K.2.1
Groff	Robert		DC_M0750		K.2.1
Grommon	Gary		DC_M2769	UCS	K.2.1
Groobert	Lawrene		DC_M7637	UCS	K.2.1
Groome	Malcolm		DC_M6855	UCS	K.2.1
Groover	Marian		DC_M4520	UCS	K.2.1
Groshardt	Joanne		DC_M7944		K.2.1
Gross	Mike		DC_M6940	UCS	K.2.1
Gross	William		DC_M3565	UCS	K.2.1
Grossman	Bonnie Dale		DC_M7014	UCS	K.2.1
Grossman	Janet		DC_M0691		K.2.1
Grote	Jan		DC_M1581	UCS	K.2.1
Grounds	Jenny	Sue Wareham	DC_F0007	Medical Association for Prevention of War (Australia)	K.3.1, K.3.2, K.3.3, K.3.4, K.3.5, K.3.11, K.3.12, K.3.13, K.3.15
Grover	Kevin		DC_M6214	UCS	K.2.1
Grover	Mark		DC_M6230	UCS	K.2.1
Grover	Ravi		DC_M7767		K.2.1
Gruber	Kenneth		DC_M1143	UCS	K.2.1
Grumman	Helen B.		DC_M0857	UCS	K.2.1
Grupp	Arthur		DC_M0620		K.2.1
Guardado	Rochelle		DC_M1199	UCS	K.2.1
Gubelman	Erin		DC_M4422	UCS	K.2.1
Guchemand	Margaret		DC_M0853	UCS	K.2.1
Gudgell	Orion		DC_M6647	UCS	K.2.1
Guenther	Michelle L.		DC_M1033	UCS	K.2.1
Guenther	Ruth		DC_M1316	UCS	K.2.1
Guerrero	Wendi		DC_M1654	UCS	K.2.1
Guida	Georgia		DC_M5100	UCS	K.2.1
Guilbault	Lauralee F		DC_M2602	UCS	K.2.1
Guillemard	Claude		DC_M7730		K.2.1
Gula	Patricia		DC_M7554	UCS	K.2.1
Gulick	Elizabeth		DC_M5863	UCS	K.2.1
Gullerud	Lois		DC_M0829	UCS	K.2.1
Gullick	Ben		DC_M5313	UCS	K.2.1
Gumban	Cristeta B.		DC_M2926	UCS	K.2.1
Gundersen	Jody		DC_M7905		K.2.1
Gunn	Kathryn		DC_M2259	UCS	K.2.1

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Gunter	Karlene		DC_F0001	Union of Concerned Scientists	K.3.7, K.3.10, K.3.14
Gunther	Peter		DC_M2551	UCS	K.2.1
Gunzel	Fred		DC_M2740	UCS	K.2.1
Gurevich	Vsevolod		DC_M0395		K.2.1
Gustafson	Chris		DC_M6127	UCS	K.2.1
Gutelius	Ken		DC_E0340		K.3.1, K.3.2, K.3.15
Guth	Jody		DC_M2627	UCS	K.2.1
Gutherie	Stephen	Jeanie Gutherie	DC_M4035	UCS	K.2.1
Gutherie	Taza		DC_M2676	UCS	K.2.1
Guthrie	Chris		DC_M3748	UCS	K.2.1
Guthrie	Elizabeth K.		DC_M6510	UCS	K.2.1
Guthrie	Elizabeth K.		DC_M6534	UCS	K.2.1
Guthrie	Pam		DC_M7439	UCS	K.2.1
Gutkowski	Marie		DC_M3541	UCS	K.2.1
Gutman	Mark		DC_M0419		K.2.1
Gutman	Mark		DC_M5333	UCS	K.2.1
Guyer	Tracy		DC_M6431	UCS	K.2.1
Gwyn	Martha		DC_M1547	UCS	K.2.1
Gwyn	Martha		DC_M1548	UCS	K.2.1
Gwyn	Martha		DC_M1551	UCS	K.2.1
Gwynneth	Mark		DC_E0339		K.3.1, K.3.3, K.3.4, K.3.7, K.3.11, K.3.12, K.3.15
H	Jen		DC_M4955	UCS	K.2.1
Haag	Mathew		DC_M3523	UCS	K.2.1
Haas	Jeff		DC_M7108	UCS	K.2.1
Haas	Margaret		DC_M5135	UCS	K.2.1
Haase	Richard		DC_M7933		K.2.1
Habenicht	Tania		DC_M2226	UCS	K.2.1
Hadler	Dale		DC_M1395	UCS	K.2.1
Hadley	Cami		DC_M4882	UCS	K.2.1
Hadley	Fawn		DC_PHO0034		K.3.18
Hadrawi	Abdul		DC_M2386	UCS	K.2.1
Hafeman	Dan		DC_M7691		K.2.1
Hafley	Sarah		DC_M0301		K.2.1
Haftl	Christine E.		DC_M1307	UCS	K.2.1
Hagelberger	Frank		DC_M5062	UCS	K.2.1
Haggbloom	Karen		DC_M1808	UCS	K.2.1
Haglund	Elaine		DC_M3078	UCS	K.2.1
Haglund	Roger		DC_M2815	UCS	K.2.1
Hagopian	James		DC_M3603	UCS	K.2.1
Hagstrom	Sean		DC_M1360	UCS	K.2.1
Hahn	Jill		DC_M3788	UCS	K.2.1
Hahn	Melissa		DC_M4401	UCS	K.2.1
Haible	John		DC_M5468	UCS	K.2.1
Haig	Maureen		DC_M6870	UCS	K.2.1
Haig	Thomas		DC_E0332	Col. USAF (retired)	K.3.2, K.3.3, K.3.5, K.3.6, K.3.7, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Haines	Karen		DC_M3022	UCS	K.2.1
Haines	Richard		DC_M0303		K.2.1
Haines	Robert		DC_M7335	UCS	K.2.1
Halderman	Terry		DC_M1291	UCS	K.2.1
Hale	Christine		DC_M3170	UCS	K.2.1
Haley	Debra		DC_M4879	UCS	K.2.1
Haley	Margie		DC_M6556	UCS	K.2.1
Hall	Alex		DC_M1416	UCS	K.2.1
Hall	Carl		DC_M6076	UCS	K.2.1
Hall	Elizabeth		DC_M6200	UCS	K.2.1

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Hall	Fred		DC_M4704	UCS	K.2.1
Hall	H. Eugene		DC_M1472	UCS	K.2.1
Hall	James		DC_M6622	UCS	K.2.1
Hall	Jean		DC_M5033	UCS	K.2.1
Hall	John		DC_M0831	UCS	K.2.1
Hall	Sach		DC_M6028	UCS	K.2.1
Hall	Steven		DC_M1448	UCS	K.2.1
Hall	Kay		DC_M4543	UCS	K.2.1
Hallahan	Janice		DC_M5631	UCS	K.2.1
Halley	Jack		DC_M2956	UCS	K.2.1
Halligan	Mary		DC_M4491	UCS	K.2.1
Hallinan	Rosemary		DC_E0143		K.2.3
Halloran	Neal		DC_M2350	UCS	K.2.1
Halmick	Michael S.		DC_M7625	UCS	K.2.1
Halpern	Lynn		DC_M0231		K.2.1
Halpern	Phyllis		DC_M2366	UCS	K.2.1
Halpert	Tasha		DC_M2756	UCS	K.2.1
Halpin	Tina		DC_M7359	UCS	K.2.1
Halward	Tracy		DC_M2717	UCS	K.2.1
Hamblen	Jennifer		DC_M0715		K.2.1
Hamel	David		DC_M4631	UCS	K.2.1
Hamel	Laura		DC_M6848	UCS	K.2.1
Hamel	Melissa		DC_M1779	UCS	K.2.1
Hamilton	Mary		DC_M4504	UCS	K.2.1
Hamilton	Mary		DC_M7115	UCS	K.2.1
Hamilton	Mary		DC_M7116	UCS	K.2.1
Hamilton	Traci		DC_M2169	UCS	K.2.1
Hamlin	Daniel	Caroline Hamlin	DC_M1184	UCS	K.2.1
Hammar	Timothy		DC_E0166		K.3.7, K.3.12, K.3.14
Hammarstrom	Bryn		DC_M3602	UCS	K.2.1
Hamme	Robyne		DC_M4125	UCS	K.2.1
Hammer	Amy		DC_M7224	UCS	K.2.1
Hammer	Elizabeth		DC_M7878		K.2.1
Hammock	Tony		DC_M5637	UCS	K.2.1
Hammond	Carol		DC_M2529	UCS	K.2.1
Hammond	James		DC_M1604	UCS	K.2.1
Hammond	Marcella		DC_M5544	UCS	K.2.1
Hammond	Stacy		DC_M6094	UCS	K.2.1
Hammond-Pettis	Elizabeth		DC_M4973	UCS	K.2.1
Hammons	Delia		DC_M5803	UCS	K.2.1
Hamon	Peter		DC_M2702	UCS	K.2.1
Hampton	Betty		DC_M4577	UCS	K.2.1
Hampton	Francesca		DC_M0401		K.2.1
Hamrick	J.C.		DC_M0076	Open Minds Open Doors	K.2.1
Hanchin	Barbara		DC_M0015		K.2.2
Hancock	Lee		DC_M1381	UCS	K.2.1
Handelsman	Robert		DC_E0199		K.3.14
Handler	Bernardine		DC_M4865	UCS	K.2.1
Hanisch	Erik		DC_M4416	UCS	K.2.1
Hanks	Jeanne		DC_M2819	UCS	K.2.1
Hanks	Laura		DC_M4634	UCS	K.2.1
Hanley	Denise		DC_M7207	UCS	K.2.1
Hanlon	Joan		DC_M4150	UCS	K.2.1
Hanna	Karel		DC_M5833	UCS	K.2.1
Hannon	Emilie		DC_M2825	UCS	K.2.1
Hannon	James		DC_M1127	UCS	K.2.1
Hanrahan	Meg		DC_M3628	UCS	K.2.1
Hanschka	Mark		DC_M5834	UCS	K.2.1

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Hansen	Amy		DC_M6499	UCS	K.2.1
Hansen	Brenda J.		DC_M0456		K.2.1
Hansen	Camilla	Aase Moeller Hansen, Eva Fidjestoel, Bhanumathi Natarajan, Marie Tjelta and Susanne Urban	DC_E0392	Bergen Peace Forum, Attac and Women's International League for Peace and Freedom	K.2.2
Hansen	Marcus		DC_M5680	UCS	K.2.1
Hansen	Peter		DC_M1823	UCS	K.2.1
Hanson	Art		DC_M0740		K.2.1
Hanson	Art		DC_M3110	UCS	K.2.1
Hanson	Art		DC_M5270	UCS	K.2.1
Hanson	Christine		DC_M3358	UCS	K.2.1
Hanson	Don		DC_M3094	UCS	K.2.1
Hanson	Donald J		DC_M7049	UCS	K.2.1
Hanson	Jennifer		DC_M2886	UCS	K.2.1
Hanson	Laura		DC_M7129	UCS	K.2.1
Hanson	Marcia		DC_M4348	UCS	K.2.1
Hanson	Natalie		DC_M0733		K.2.1
Hanson	Natalie		DC_M3158	UCS	K.2.1
Hanson	Natalie		DC_M3159	UCS	K.2.1
Hanson	Natalie		DC_M3169	UCS	K.2.1
Hanta	Hashi		DC_M1167	UCS	K.2.1
Harbst	Mark		DC_M7845		K.3.2, K.3.7, K.3.11
Harbus	Richard		DC_M7411	UCS	K.2.1
Harbutt	Charles		DC_M4798	UCS	K.2.1
Harclerode	Rebecca		DC_M2110	UCS	K.2.1
Harden	Brandi		DC_M1921	UCS	K.2.1
Hardersen	Paul		DC_M3910	UCS	K.2.1
Hardey	Pat	Jo An Bell	DC_M0253		K.2.2
Hardin	Judy		DC_M3516	UCS	K.2.1
Harding	Kevin		DC_M6038	UCS	K.2.1
Harding	Tara		DC_M7187	UCS	K.2.1
Hardwick	Barbara		DC_M0057		K.2.1
Hardy	Ann		DC_M7446	UCS	K.2.1
Hardy	Cherri		DC_M4689	UCS	K.2.1
Hardy	H Nick		DC_M5614	UCS	K.2.1
Hardy	Kenneth		DC_M6721	UCS	K.2.1
Hardy	Sharon		DC_M1880	UCS	K.2.1
Hargis-Bullen	Rachael		DC_M3865	UCS	K.2.1
Hargraves	Darla		DC_M0521		K.2.1
Hargraves	Darla		DC_M0525		K.2.1
Hargreave	Lynette		DC_M5827	UCS	K.2.1
Harig	Carl		DC_M3927	UCS	K.2.1
Harkins	Hugh		DC_M5017	UCS	K.2.1
Harley	Betts		DC_M6559	UCS	K.2.1
Harmon	Bobby		DC_M3398	UCS	K.2.1
Harmon	Joan		DC_M7812		K.2.1
Harms	Sharon		DC_M2184	UCS	K.2.1
Harp	Carol Lynn		DC_M3219	UCS	K.2.1
Harper	George M		DC_M7047	UCS	K.2.1
Harper	Jeannette		DC_M6049	UCS	K.2.1
Harper	Joseph and Patricia		DC_M1954	UCS	K.2.1
Harper	Julie		DC_M7325	UCS	K.2.1
Harper	Laura		DC_M1789	UCS	K.2.1
Harper	Marian		DC_M6304	UCS	K.2.1
Harper	Rebecca		DC_M6742	UCS	K.2.1

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Harper	Shannon		DC_M1712	UCS	K.2.1
Harrell	Ben		DC_M4140	UCS	K.2.1
Harrell	Nanka		DC_M2900	UCS	K.2.1
Harrer	Julie		DC_M7681	UCS	K.2.1
Harried	Michelle		DC_M6888	UCS	K.2.1
Harries	Thomas		DC_M5565	UCS	K.2.1
Harriman	Guy		DC_M7092	UCS	K.2.1
Harrington	Eileen		DC_M3901	UCS	K.2.1
Harrington	Margaret		DC_M2144	UCS	K.2.1
Harrington	Patrick		DC_M4782	UCS	K.2.1
Harris	Angie		DC_M2504	UCS	K.2.1
Harris	Carroll		DC_M1110	UCS	K.2.1
Harris	David	Sue Harris	DC_M1364	UCS	K.2.1
Harris	Emily		DC_M0362		K.2.1
Harris	Erin		DC_M2404	UCS	K.2.1
Harris	Joan		DC_M1639	UCS	K.2.1
Harris	Laura		DC_M7556	UCS	K.2.1
Harris	Melinda		DC_M7287	UCS	K.2.1
Harris	Michael		DC_M6589	UCS	K.2.1
Harris	Michelle		DC_M1800	UCS	K.2.1
Harris	Susan		DC_M4445	UCS	K.2.1
Harris	Dale		DC_M6082	UCS	K.2.1
Harrison	Dan		DC_M0370		K.2.1
Harrison	Mark		DC_M3672	UCS	K.2.1
Harrison	Richard		DC_M3417	UCS	K.2.1
Harrison	William		DC_M6010	UCS	K.2.1
Harrod	Annemarie		DC_M7859		K.2.1
Harrod	Katherine		DC_M1647	UCS	K.2.1
Hart	Becky		DC_M7748		K.2.1
Hart	Jess		DC_M6393	UCS	K.2.1
Hart	Joan		DC_M7354	UCS	K.2.1
Hart	Jess		DC_M6383	UCS	K.2.1
Harte	Julia		DC_M6353	UCS	K.2.1
Harte	Mary Ellen		DC_M6621	UCS	K.2.1
Harter	Theo		DC_M6827	UCS	K.2.1
Hartl	Ken		DC_M2691	UCS	K.2.1
Hartman	Julia		DC_M2633	UCS	K.2.1
Hartsough	David		DC_E0370	paceworkers/nonviolent Peaceforce	K.2.2
Harvey	Loreen		DC_M2354	UCS	K.2.1
Harvey-Marose	Kevin		DC_M3057	UCS	K.2.1
Harwood	Susana		DC_M7506	UCS	K.2.1
Haseltine	Allan		DC_M0416		K.2.1
Haseltine	Allan		DC_M1037	UCS	K.2.1
Hasenbein	Sister Francine		DC_M1847	UCS	K.2.1
Haslam	Malissa		DC_M5223	UCS	K.2.1
Hass	Marjorie		DC_M4373	UCS	K.2.1
Hassa	Linda		DC_M6112	UCS	K.2.1
Hass-Holcombe	Aleita		DC_E0277		K.2.2
Hassman	Howard		DC_M6527	UCS	K.2.1
Hastings	Sandie		DC_M0555		K.2.1
Hatfield	Lucretia		DC_M5701	UCS	K.2.1
Hathaway	Christopher		DC_M1706	UCS	K.2.1
Hatleberg	Earl		DC_M2912	UCS	K.2.1
Haugan	Anne E.		DC_M1421	UCS	K.2.1
Haugan	Janice		DC_M5756	UCS	K.2.1
Haugen	Lisa		DC_M7300	UCS	K.2.1
Haughton	Theodora		DC_M6162	UCS	K.2.1
Haughton	Theodora		DC_M7754		K.2.1

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Havercamp	Micheal		DC_M2089	UCS	K.2.1
Haverkamp	Patricia		DC_M7641	UCS	K.2.1
Hawkins	Dimity		DC_E0410/ DC_F0005	Medical Association for Prevention of War (Western Australian Branch)	K.3.9
Hawkins	Michaelynn		DC_M6054	UCS	K.2.1
Hawkins	Robert		DC_M3282	UCS	K.2.1
Hawkins	Shereen		DC_M4607	UCS	K.2.1
Hawrylik	Marilyn		DC_M4599	UCS	K.2.1
Hayaward	Barbara		DC_M0914	UCS	K.2.1
Hayaward	Barbara		DC_M4936	UCS	K.2.1
Haydamacha	Tina		DC_M4083	UCS	K.2.1
Hayden	William		DC_E0152		K.3.2, K.3.14
Hayes	Amy		DC_M7558	UCS	K.2.1
Hayes	David		DC_M5598	UCS	K.2.1
Hayes	Mark		DC_M7768		K.2.1
Hayes	Scott		DC_M5498	UCS	K.2.1
Haygood	Jay		DC_M7315	UCS	K.2.1
Hayhurst	Derek		DC_M0460		K.2.1
Haymon	David		DC_M1070	UCS	K.2.1
Hayner	April		DC_M5552	UCS	K.2.1
Haynes-Paton	T.		DC_E0236		K.3.3, K.3.10, K.3.12, K.3.13
Hays	Lynn		DC_M0236		K.2.2
Hays	Walter		DC_M5783	UCS	K.2.1
Hayward	Elizabeth		DC_M6943	UCS	K.2.1
Hayward	Judith		DC_M5945	UCS	K.2.1
Hayward	Rachel		DC_M5261	UCS	K.2.1
Hazelton	Harry		DC_M2008	UCS	K.2.1
Hazelton	J		DC_M0690		K.2.1
Hazen	Chad		DC_M0835	UCS	K.2.1
Hazen	Libby		DC_M3155	UCS	K.2.1
Hazlett	Stephanie		DC_M4409	UCS	K.2.1
Hazzard	Norman		DC_M3583	UCS	K.2.1
Heacker	Gina		DC_M7551	UCS	K.2.1
Head	Jeremy		DC_M3944	UCS	K.2.1
Head	Kevin		DC_M3885	UCS	K.2.1
Healthcoat	Elaine		DC_M6289	UCS	K.2.1
Heaps	Joan		DC_M6370	UCS	K.2.1
Heasom	William		DC_M7782		K.2.1
Heath	Al		DC_M1069	UCS	K.2.1
Heath	Rose		DC_M1205	UCS	K.2.1
Heathcoat	Elaine		DC_M2094	UCS	K.2.1
Hebert	Lee		DC_M2018	UCS	K.2.1
Heburn	Chet		DC_M2609	UCS	K.2.1
Hecht	Chris		DC_M5310	UCS	K.2.1
Hedlund	Nick		DC_M6929	UCS	K.2.1
Heeber	Alisa		DC_M2767	UCS	K.2.1
Heer	John		DC_M6344	UCS	K.2.1
Heeschen	Judith		DC_M3285	UCS	K.2.1
Hefner	Elizabeth		DC_M4565	UCS	K.2.1
Hegarty	Robert		DC_M3273	UCS	K.2.1
Hege	E. Keith		DC_M1181	UCS	K.2.1
Hegmann	Elisabeth		DC_M4609	UCS	K.2.1
Hegney	Scott		DC_M1617	UCS	K.2.1
Heiden	Jessica		DC_M6823	UCS	K.2.1
Heidt	Jeff		DC_M3189	UCS	K.2.1
Heil	Nicola		DC_M4223	UCS	K.2.1
Heil	Roselyn		DC_M2092	UCS	K.2.1

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Heimbach	La Yvonne		DC_M1284	UCS	K.2.1
Heinonen	Valerie		DC_M7841		K.2.3
Heinrich	Cybele		DC_M3831	UCS	K.2.1
Heinrich	Heidi		DC_M3790	UCS	K.2.1
Heinsch	Faith Ann		DC_M1795	UCS	K.2.1
Heisler	Mike		DC_M3869	UCS	K.2.1
Heitjan	Dorothy		DC_M1682	UCS	K.2.1
Heitman	Carolyn		DC_E0002		K.3.9
Heitman	Carolyn		DC_E0063		K.3.9
Heitman	Carolyn		DC_E0319		K.3.11, K.3.12, K.3.13, K.3.15, K.4
Heitsch	Irene		DC_M2599	UCS	K.2.1
Heitz	Gary		DC_M4313	UCS	K.2.1
Heitz	Rebecca D.		DC_M4585	UCS	K.2.1
Helferich	Molly R.		DC_M1433	UCS	K.2.1
Helland	Susan		DC_M4686	UCS	K.2.1
Heller	Marika		DC_M1986	UCS	K.2.1
Hellyer	Greg		DC_M1571	UCS	K.2.1
Helm	Pen		DC_M3999	UCS	K.2.1
Helmers	Nancy		DC_M0328		K.2.1
Helmes	Phyllis		DC_M4908	UCS	K.2.1
Helmin	Jenine		DC_M1627	UCS	K.2.1
Hemlin	Lila		DC_E0348		K.3.1, K.3.2, K.3.3, K.3.10, K.3.11, K.3.12
Henderson	Barbara		DC_M0546		K.2.1
Henderson	David		DC_M2195	UCS	K.2.1
Henderson	Dorea		DC_M0673		K.2.1
Henderson	Lillian		DC_M2344	UCS	K.2.1
Henderson	Phyllis		DC_M2146	UCS	K.2.1
Henderson	Roger C.		DC_M1251	UCS	K.2.1
Hendlish	Abe		DC_M0467		K.2.1
Hendon	Jodi		DC_M3396	UCS	K.2.1
Hendren	Lanette		DC_M5009	UCS	K.2.1
Hendricks	M.L.		DC_M7293	UCS	K.2.1
Hendrickson	Randy		DC_M7528	UCS	K.2.1
Henke	Jill		DC_M2666	UCS	K.2.1
Henke	Jill		DC_M7491	UCS	K.2.1
Henneman	Chip		DC_M5116	UCS	K.2.1
Hennessy	Al		DC_M5835	UCS	K.2.1
Hennigar	Logadia		DC_M1125	UCS	K.2.1
Henriksen	Helle		DC_M4174	UCS	K.2.1
Henry	Alvin		DC_M7321	UCS	K.2.1
Henry	Christopher		DC_M2718	UCS	K.2.1
Henry	Christopher		DC_M2784	UCS	K.2.1
Henry	David		DC_M7689		K.3.7, K.3.10, K.3.13, K.3.15
Henry	Russell		DC_M3594	UCS	K.2.1
Henry	Steve		DC_M3149	UCS	K.2.1
Henshaw	Mel		DC_M4640	UCS	K.2.1
Henze	Christine		DC_M2065	UCS	K.2.1
Herberger	Abby		DC_M1488	UCS	K.2.1
Herbert	Crystal		DC_M1361	UCS	K.2.1
Herbert	Crystal		DC_M1362	UCS	K.2.1
Herbert	Leigh		DC_E0309		K.2.2
Herbruck	Janet		DC_M5463	UCS	K.2.1
Herland	Holly J.		DC_M7089	UCS	K.2.1
Herman	Lee		DC_M5758	UCS	K.2.1
Hernandez	April		DC_M5210	UCS	K.2.1
Hernandez	Guillermo		DC_M3069	UCS	K.2.1
Herne	Jennifer		DC_M7649	UCS	K.2.1

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Herness	Michelle		DC_M6779	UCS	K.2.1
Hernon	Joseph		DC_M7712		K.3.14, K.3.17
Heron	Joan		DC_M0074		K.2.1
Herrera	Michelle		DC_M6715	UCS	K.2.1
Herrero	Marta		DC_M6796	UCS	K.2.1
Herrmann	Renita		DC_M4441	UCS	K.2.1
Herron	Wendy		DC_M2903	UCS	K.2.1
Hersey	Patricia		DC_M4260	UCS	K.2.1
Hershey	Randy		DC_M4310	UCS	K.2.1
Herstein	Gary		DC_M1599	UCS	K.2.1
Hervatin	Shirley		DC_M7131	UCS	K.2.1
Hess	Dan		DC_M4995	UCS	K.2.1
Hess	Joseph		DC_M4156	UCS	K.2.1
Hessen	Patti		DC_M0944	UCS	K.2.1
Hessenaur	Roxan		DC_M7369	UCS	K.2.1
Hessler	Gary		DC_M0820	UCS	K.2.1
Hetrick	Kay		DC_M4875	UCS	K.2.1
Hetzel	Bob		DC_E0227		K.3.1, K.3.3
Heuman	Christopher S.		DC_M1619	UCS	K.2.1
Hewitt	David W.		DC_M3743	UCS	K.2.1
Hewitt	Patricia		DC_M4878	UCS	K.2.1
Hewitt	Rosalie		DC_M6872	UCS	K.2.1
Heyde	Paul		DC_M2550	UCS	K.2.1
Hiatt	Richard		DC_M3275	UCS	K.2.1
Hickenbottom	Norman		DC_M4200	UCS	K.2.1
Hickman	Russ		DC_M2816	UCS	K.2.1
Hickman	Wendy		DC_M6318	UCS	K.2.1
Hicks	Amalia		DC_M2205	UCS	K.2.1
Hicks	David		DC_M4494	UCS	K.2.1
Hicks	Robert A.		DC_M1150	UCS	K.2.1
Hicks	Whitney		DC_M7725		K.2.1
Hieb	Andrew		DC_M1138	UCS	K.2.1
Higbee	Audrey		DC_M3389	UCS	K.2.1
Higgins	Beth		DC_M1292	UCS	K.2.1
Higgins	Beth		DC_M6163	UCS	K.2.1
Higgins	Brittany		DC_M2337	UCS	K.2.1
High	Mardy		DC_M5946	UCS	K.2.1
Highland	Anne		DC_M1306	UCS	K.2.1
Hilbrandt	Julia M.		DC_M6871	UCS	K.2.1
Hildebrandt	Joel		DC_M3163	UCS	K.2.1
Hildebrandt	Todd		DC_M2595	UCS	K.2.1
Hilder	Margaret		DC_M5993	UCS	K.2.1
Hilder	Rebecca		DC_M6130	UCS	K.2.1
Hilgerman	Mary Ann		DC_M4117	UCS	K.2.1
Hill	Frieda		DC_M7160	UCS	K.2.1
Hill	Gregory		DC_M5845	UCS	K.2.1
Hill	Joann		DC_M4952	UCS	K.2.1
Hill	Karen		DC_M7421	UCS	K.2.1
Hill	Maureen		DC_M0039		K.2.1
Hill	Rosco		DC_M4273	UCS	K.2.1
Hill	Suzanne		DC_M4314	UCS	K.2.1
Hilliard	Marion		DC_M7510	UCS	K.2.1
Hilson	Robert		DC_M6724	UCS	K.2.1
Hilton	Julie		DC_M1794	UCS	K.2.1
Hinchliffe	John		DC_M0255		K.2.2
Hinderstein	Karen		DC_M6777	UCS	K.2.1
Hinds	Marilyn		DC_M1453	UCS	K.2.1
Hines	Lisa		DC_M5412	UCS	K.2.1
Hines	Lori		DC_M4172	UCS	K.2.1

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Hinkley	Pat		DC_M5929	UCS	K.2.1
Hinman	Dorothy		DC_M4158	UCS	K.2.1
Hinman	Jan		DC_M7264	UCS	K.2.1
Hinnant	John		DC_M2814	UCS	K.2.1
Hinnant	John		DC_M5958	UCS	K.2.1
Hinnant	John		DC_M5961	UCS	K.2.1
Hinnebusch	Mark		DC_M4387	UCS	K.2.1
Hinz	Nicholas		DC_M7345	UCS	K.2.1
Hiramatsu	Sandra		DC_M0864	UCS	K.2.1
Hiramatsu	Sandra		DC_M7276	UCS	K.2.1
Hirsch	Barbara		DC_M5028	UCS	K.2.1
Hirsch	Cherie		DC_M3038	UCS	K.2.1
Hirsch	Harriet		DC_M4727	UCS	K.2.1
Hirt	James		DC_M5633	UCS	K.2.1
Hirt	Kristin		DC_M5724	UCS	K.2.1
Hirth	Carol		DC_M0873	UCS	K.2.1
Hise	Diane		DC_M7379	UCS	K.2.1
Hitch	Alan		DC_M5264	UCS	K.2.1
Hitchens	Theresa		DC_PHO0002	Center for Defense Information	K.4
Hitchens	Theresa		DC_PHW0003	Center for Defense Information	K.3.3, K.3.15, K.4
Hively	Jan		DC_E0224		K.2.2
Hlavna	Penny		DC_M3206	UCS	K.2.1
Hnatowich	Marcia		DC_M5095	UCS	K.2.1
Ho	Rebecca		DC_M3978	UCS	K.2.1
Hoad	Karin		DC_M1418	UCS	K.2.1
Hoaglund	Maria		DC_M0102		K.2.1
Hochberg	Harris		DC_M1754	UCS	K.2.1
Hock	Judy		DC_M0232		K.2.1
Hodgson	John		DC_M4576	UCS	K.2.1
Hoeh	Walter		DC_M4927	UCS	K.2.1
Hoerlein	Robert		DC_M7923		K.2.1
Hoerr	James		DC_M4632	UCS	K.2.1
Hoff	Marilyn		DC_E0286		K.3.1, K.3.2, K.3.3, K.3.5, K.3.11, K.3.13, K.3.15
Hoff	Marilyn		DC_M4391	UCS	K.2.1
Hoffberg	Judith		DC_M4146	UCS	K.2.1
Hoffer	Lois		DC_M7299	UCS	K.2.1
Hoffman	Frances		DC_E0254		K.2.2
Hoffman	Frances		DC_M1061	UCS	K.2.1
Hoffman	Stuart		DC_M4364	UCS	K.2.1
Hoffman	Stuart		DC_M7756		K.2.1
Hoffman	Valerie		DC_M6539	UCS	K.2.1
Hoffmann	Kit		DC_M2849	UCS	K.2.1
Hofman	James		DC_M7531	UCS	K.2.1
Hogan	Cynthia		DC_M3580	UCS	K.2.1
Hogan	Jennifer		DC_M5184	UCS	K.2.1
Hogu	Paul		DC_M4194	UCS	K.2.1
Hogue	Caroline		DC_M6458	UCS	K.2.1
Hohenberg	Adrienne		DC_M4948	UCS	K.2.1
Hohenemser	Chris		DC_M0058		K.3.1, K.10, K.3.11
Hoistad	Gerald		DC_M1805	UCS	K.2.1
Hojohn	Wendy		DC_M1367	UCS	K.2.1
Hokanson	Gene		DC_E0134		K.3.1, K.3.2, K.3.10, K.3.13, K.3.14
Holaday	Susan		DC_M5719	UCS	K.2.1
Holden	Michael		DC_M0794	UCS	K.2.1
Holden	Nichole		DC_M3620	UCS	K.2.1

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Holesovsky	Renee		DC_M0312		K.2.1
Holifield	Helen		DC_M2612	UCS	K.2.1
Holland	Loretta		DC_M6817	UCS	K.2.1
Holland	Ronald		DC_M1218	UCS	K.2.1
Holland	Theodore		DC_M6863	UCS	K.2.1
Hollenbach	Ruth		DC_M6368	UCS	K.2.1
Holley	James W.		DC_M4006	UCS	K.2.1
Hollis	Barbara		DC_M5541	UCS	K.2.1
Hollis	Megan		DC_M3669	UCS	K.2.1
Hollman	Fredde		DC_M7802		K.2.3
Holloway	Deborah		DC_M5093	UCS	K.2.1
Holloway	Deborah		DC_M6251	UCS	K.2.1
Holloway	Katherine		DC_E0383		K.3.1, K.3.2, K.3.12, K.3.15
Hollowell	Jennifer		DC_M7174	UCS	K.2.1
Holman	Tara		DC_M3372	UCS	K.2.1
Holmes	Joseph		DC_M4887	UCS	K.2.1
Holowicki	Tammy		DC_M5190	UCS	K.2.1
Holt	Jesse		DC_M0441		K.2.1
Holte	Inese		DC_M4618	UCS	K.2.1
Holtrop	Elizabeth Bouma		DC_M0129		K.2.1
Holtz	Eileen		DC_M3646	UCS	K.2.1
Holtzman	Michelle		DC_M1562	UCS	K.2.1
Homan	Dan		DC_M7797		K.3.7, K.3.13, K.3.15
Homer	Deanna		DC_M6892	UCS	K.2.1
Honish	David		DC_M2951	UCS	K.2.1
Hons	Thomas		DC_M0955	UCS	K.2.1
Hoo	Lanlan		DC_M4807	UCS	K.2.1
Hoodwin	Marcia		DC_M0616		K.2.1
Hooker	Betsey		DC_M7890		K.2.1
Hoover	Janet		DC_M6683	UCS	K.2.1
Hoover	Karen		DC_M2998	UCS	K.2.1
Hoover	Mary Anne		DC_M5284	UCS	K.2.1
Hoover	Tricia		DC_M5859	UCS	K.2.1
Hope	Elizabeth		DC_M1501	UCS	K.2.1
Hopf	David		DC_M7708		K.2.1
Hopkins	Steve		DC_M0162		K.3.14
Hopper	Pam		DC_M2929	UCS	K.2.1
Hopper	Thomas		DC_M6593	UCS	K.2.1
Horeluk	Tara		DC_M6299	UCS	K.2.1
Horenstine	Susan		DC_M3514	UCS	K.2.1
Hormann	Theo		DC_M0822	UCS	K.2.1
Horn	Bill		DC_M5448	UCS	K.2.1
Horn	Stephen		DC_M7877		K.2.1
Horn	Susan		DC_M5200	UCS	K.2.1
Hornberger	Susanne		DC_M0522		K.2.1
Horne	Jeff		DC_M7638	UCS	K.2.1
Horne	Kenneth		DC_M2063	UCS	K.2.1
Hornfeld	Gary		DC_M5003	UCS	K.2.1
Horning	Michelle		DC_M1297	UCS	K.2.1
Horst	Leslie		DC_M3763	UCS	K.2.1
Horton	Harriet		DC_M1718	UCS	K.2.1
Horwitz	Lawrence		DC_M4181	UCS	K.2.1
Hoskins	Catherine		DC_M7260	UCS	K.2.1
Hosler	Pamela		DC_M1500	UCS	K.2.1
Hosseinion	Ali		DC_PHO0021		K.3.2
Hostetter	Emily		DC_M5280	UCS	K.2.1
Hotchkiss	Babette		DC_M1156	UCS	K.2.1
Hough	Nancy		DC_M4580	UCS	K.2.1
Hough	Peggy		DC_M0340		K.2.1

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Houghton	Abigail		DC_M5453	UCS	K.2.1
Houghton	Alex		DC_M1302	UCS	K.2.1
Houghton	Jack		DC_M7606	UCS	K.2.1
Houle	Janet		DC_M0568		K.2.1
House	Vanessa		DC_M4500	UCS	K.2.1
Houser	Jerry		DC_M2657	UCS	K.2.1
Houston	Dorothy		DC_PHO0016		K.3.1, K.3.2, K.3.3, K.3.4, K.3.5, K.3.11
Houston	Lynn		DC_E0005		K.2.2
Houston	Lynn		DC_M2480	UCS	K.2.1
Houston	Matthew Travis		DC_M0155		K.2.1
Houston	Robert		DC_M3758	UCS	K.2.1
Hovey	Amanda		DC_M3399	UCS	K.2.1
Howald	Shanna		DC_M2543	UCS	K.2.1
Howald	William		DC_M5799	UCS	K.2.1
Howard	Alice		DC_M7740		K.2.3
Howard	David		DC_M6927	UCS	K.2.1
Howard	Graham		DC_M4864	UCS	K.2.1
Howard	Jessica		DC_M4713	UCS	K.2.1
Howard	Steven		DC_E0021		K.3.1, K.3.2, K.3.3, K.3.4, K.3.12, K.3.13, K.3.15
Howard	Theodore		DC_M3046	UCS	K.2.1
Howard	William		DC_M4033	UCS	K.2.1
Howatt	G		DC_M7896		K.2.1
Howd	Robert		DC_E0376	Office of Environmental Health Hazard Assessment Oakland, CA 94612	K.4
Howe	Jared		DC_M7458	UCS	K.2.1
Howell	Marilyn		DC_M2877	UCS	K.2.1
Howells	Lynda		DC_M2867	UCS	K.2.1
Hower	Judith		DC_M0086		K.2.1
Howse	Robin		DC_M2190	UCS	K.2.1
Hoyer	Eric		DC_M3681	UCS	K.2.1
Hruska	Elias		DC_M4710	UCS	K.2.1
Hsieh	Efan		DC_M6023	UCS	K.2.1
Hsu	Margaret		DC_M5703	UCS	K.2.1
Hubard	Libby		DC_E0216		K.3.3, K.3.12, K.3.15, K.4
Hubbell	Paige		DC_M1493	UCS	K.2.1
Huber	Ernest		DC_M3823	UCS	K.2.1
Huber	Gerald		DC_M7677	UCS	K.2.1
Huckins	George		DC_M4667	UCS	K.2.1
Huddlestone	Laura		DC_M5759	UCS	K.2.1
Hudgins	Andrew		DC_M2133	UCS	K.2.1
Hudgins	William G.		DC_M5133	UCS	K.2.1
Hudleson	Nordica		DC_M5749	UCS	K.2.1
Hudnall	Eric		DC_M0717		K.2.1
Hudnell	Alan		DC_M2045	UCS	K.2.1
Hudnut	Robert		DC_M3828	UCS	K.2.1
Hudock	Jim		DC_M4009	UCS	K.2.1
Hudson	Laura		DC_M4429	UCS	K.2.1
Hudson	Leslie J.		DC_M2944	UCS	K.2.1
Hudson	Rick		DC_M0654		K.2.1
Huebner	Albert		DC_M3935	UCS	K.2.1
Huebner	Tanya		DC_M5906	UCS	K.2.1
Huemmer	Nick		DC_M1050	UCS	K.2.1
Huerta	Ernest		DC_M3449	UCS	K.2.1
Huff	Lisa		DC_M0462		K.2.1
Huff	Lisa		DC_M7608	UCS	K.2.1

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Huffman	Amie		DC_M2209	UCS	K.2.1
Huffman	Margaret L.		DC_M4569	UCS	K.2.1
Hugel	Paul		DC_M1922	UCS	K.2.1
Huggins	Irene		DC_M5880	UCS	K.2.1
Hughes	Angie		DC_M5553	UCS	K.2.1
Hughes	Jennifer		DC_M5287	UCS	K.2.1
Hughes	K.A.		DC_M0939	UCS	K.2.1
Hughes	Linda		DC_E0323		K.2.2
Hughes	Patricia		DC_M7471	UCS	K.2.1
Hughes	Robert M.		DC_M3700	UCS	K.2.1
Huidobro	Michael		DC_M3737	UCS	K.2.1
Huie	Serena		DC_M4537	UCS	K.2.1
Hull	Lucy		DC_M6977	UCS	K.2.1
Hull	Margaret		DC_M0952	UCS	K.2.1
Hull	Markwood		DC_M6239	UCS	K.2.1
Hulse	Elyse		DC_M4300	UCS	K.2.1
Hultgren	David		DC_M4421	UCS	K.2.1
Hume	Peter		DC_M3484	UCS	K.2.1
Humes	Leah		DC_M6778	UCS	K.2.1
Humke	Patrice		DC_M4826	UCS	K.2.1
Humme	Cheryl		DC_M1454	UCS	K.2.1
Hunn	Gail		DC_M7454	UCS	K.2.1
Hunt	Carole		DC_M1786	UCS	K.2.1
Hunt	James		DC_M2145	UCS	K.2.1
Hunter	Kay		DC_M4333	UCS	K.2.1
Huntman	Bret		DC_M6958	UCS	K.2.1
Hurban	Richard		DC_E0118		K.3.14
Hurd	John		DC_E0296		K.2.2
Hurd	John		DC_M6232	UCS	K.2.1
Hurlbert	Ronald		DC_M1382	UCS	K.2.1
Hurley	Bridget		DC_M0972	UCS	K.2.1
Hurliman	Bonnie		DC_M4849	UCS	K.2.1
Hurte	Nancy		DC_M6975	UCS	K.2.1
Hurwitz	Art		DC_M1658	UCS	K.2.1
Hurwitz	Debbie		DC_M2317	UCS	K.2.1
Hussey	Ikaika		DC_PHO0058		K.3.1, K.3.4, K.3.11, K.3.12, K.3.15, K.4
Hutchings	Noel		DC_M1837	UCS	K.2.1
Hutchins	Karmen		DC_M6704	UCS	K.2.1
Hutchinson	Peggy		DC_M7386	UCS	K.2.1
Hutchinson	Randi		DC_M7456	UCS	K.2.1
Hutchison	Judith		DC_M5246	UCS	K.2.1
Hutton	Micheal S		DC_M3227	UCS	K.2.1
Hutton	Stephanie		DC_M6836	UCS	K.2.1
Hyatt	Don		DC_M7332	UCS	K.2.1
Hyatt	Donna		DC_M4160	UCS	K.2.1
Hyatt	Donna		DC_M4162	UCS	K.2.1
Hyde	Ralph		DC_M2722	UCS	K.2.1
Hyde	Ralph		DC_M2724	UCS	K.2.1
Hydeman	Jinx		DC_M2883	UCS	K.2.1
Hyder	Sherrie		DC_M0945	UCS	K.2.1
Hydro	Mary		DC_M5392	UCS	K.2.1
Hyers	Anisha		DC_M7256	UCS	K.2.1
Hyman	Rudoff		DC_E0037		K.2.2
Hymer	Monica		DC_M1145	UCS	K.2.1
Hynes	Kathryn A		DC_M2232	UCS	K.2.1
Iacono	David J.		DC_M0538		K.2.1
Iannone	Karen		DC_M1579	UCS	K.2.1
Ibison	Micahael		DC_E0142		K.3.14, K.4

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Ichiriu	Ed		DC_M3430	UCS	K.2.1
Ievins	Janet		DC_M1354	UCS	K.2.1
Ignacio	Christine		DC_M2679	UCS	K.2.1
Ilardi	Virginia		DC_M7093	UCS	K.2.1
illedgible	William		DC_M0034		K.2.1
Iltzsche	William		DC_M5966	UCS	K.2.1
Imbody	Ellen		DC_M6161	UCS	K.2.1
Ingalsbe	David		DC_M7433	UCS	K.2.1
Ingerman	Karen		DC_M6327	UCS	K.2.1
Inglehart	Debbie		DC_M1861	UCS	K.2.1
Inglis	William		DC_M2073	UCS	K.2.1
Ingraham-Malchow	Tami		DC_M1602	UCS	K.2.1
Ingram	Shawn		DC_M2439	UCS	K.2.1
Inkip	Eleanor		DC_M4863	UCS	K.2.1
Inouye	Arlene		DC_M6132	UCS	K.2.1
Inouye	Brain		DC_M6014	UCS	K.2.1
Inouye	Brian		DC_E0173		K.3.14
Interis	Evelyn		DC_M7487	UCS	K.2.1
Intili	Celia		DC_M7815		K.2.1
Ipock	Dorita		DC_M4360	UCS	K.2.1
Iracki	Donna		DC_M2332	UCS	K.2.1
Ireland	Linda		DC_M7800		K.2.3
Ireland-Frey	Louise		DC_M4480	UCS	K.2.1
Irion	Lindsay		DC_M6747	UCS	K.2.1
Irwin	Harry		DC_M2132	UCS	K.2.1
Isenman	Donald Carl		DC_M0421		K.2.1
Isenman	Donald Carl		DC_M7922		K.2.1
Isensee	Chris		DC_M2208	UCS	K.2.1
Islan	Hampton		DC_E0279		K.2.2
Italiano	Debra		DC_M0309		K.2.1
Ivankovic	Anthony		DC_M6051	UCS	K.2.1
Iverson	Karen		DC_M2408	UCS	K.2.1
Iverson	Miriam		DC_M7001	UCS	K.2.1
Ivy	A.T.		DC_M3301	UCS	K.2.1
Jabs	Sharon		DC_M7222	UCS	K.2.1
Jack Community Pharmacy			DC_M5202	UCS	K.2.1
Jackanicz	Theodore		DC_M1927	UCS	K.2.1
Jackowsky	Meredith		DC_M0614		K.2.1
Jackson	Amy		DC_M1928	UCS	K.2.1
Jackson	Carla		DC_M3546	UCS	K.2.1
Jackson	Diane		DC_M1485	UCS	K.2.1
Jackson	Erlene		DC_M4954	UCS	K.2.1
Jackson	Shawn		DC_M1504	UCS	K.2.1
Jackson	Stephanie		DC_M0598		K.2.1
Jackson	Tom	Tina Jackson	DC_M3311	UCS	K.2.1
Jackson	Tom		DC_M7234	UCS	K.2.1
Jackson	Tom & Tina		DC_M2029	UCS	K.2.1
Jackson	Vanessa		DC_M2173	UCS	K.2.1
Jackson	Vanessa		DC_M2361	UCS	K.2.1
Jackson	Weldon		DC_M5789	UCS	K.2.1
Jacob	Julie		DC_E0082		K.2.2
Jacob	Michael		DC_M7757		K.2.1
Jacobie	Ken		DC_M5885	UCS	K.2.1
Jacobs	Marilyn		DC_M0526		K.2.1
Jacobsen	Lynne		DC_M6790	UCS	K.2.1
Jacobson	Albert S.		DC_M4668	UCS	K.2.1
Jacoby	Jamie		DC_M3150	UCS	K.2.1

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Jacus	Anna		DC_E0368		K.2.3
Jaeger	Dieter		DC_M3023	UCS	K.2.1
Jaeger	Jennifer		DC_M6692	UCS	K.2.1
Jaffe	A		DC_M7543	UCS	K.2.1
Jaffe	Wilma		DC_M5236	UCS	K.2.1
Jakimowski	Michal		DC_M1780	UCS	K.2.1
James	Lowell		DC_M6208	UCS	K.2.1
Jamieson	Ellen		DC_M4581	UCS	K.2.1
Jamvold	Shunko		DC_M5384	UCS	K.2.1
Janeiro	Aurelio		DC_M2935	UCS	K.2.1
Jankowski	Ethan		DC_M5443	UCS	K.2.1
Jannone	Dan		DC_M4979	UCS	K.2.1
Janowitz-Price	Beverly		DC_M6160	UCS	K.2.1
Jansons	Andrejs		DC_M3821	UCS	K.2.1
Janssen	M.W.		DC_M1412	UCS	K.2.1
Janssen	Sarah		DC_M6348	UCS	K.2.1
Janus	Joan		DC_M0618		K.2.1
Janusko	Robert		DC_M6125	UCS	K.2.1
Janzen	Gayle		DC_M4584	UCS	K.2.1
Janzen	Shawn		DC_M3318	UCS	K.2.1
Jarboe	JoLynn		DC_M4202	UCS	K.2.1
Jarrell	Linda		DC_M1575	UCS	K.2.1
Jarvis	Scott		DC_M7360	UCS	K.2.1
Jaskoski	Helen		DC_M1241	UCS	K.2.1
Jaskowski	Helen		DC_PHO0015		K.3.1, K.3.13
Jaskowski	Mariusz		DC_M4442	UCS	K.2.1
Jasper	Lea Anne		DC_M7742		K.2.1
Javed	Diane		DC_M6197	UCS	K.2.1
Jawlick	Mary		DC_M0582		K.2.1
Jazzborne	September		DC_M4496	UCS	K.2.1
Jeanne	Kresser		DC_M6802	UCS	K.2.1
Jefferson	Kaneesah		DC_M7130	UCS	K.2.1
Jefferson	Kaneesha		DC_M4833	UCS	K.2.1
Jeffery	Raymond		DC_M3433	UCS	K.2.1
Jefferys	Alan		DC_E0222		K.3.4, K.3.11
Jeffrey	Daniel		DC_M4473	UCS	K.2.1
Jeffries	Michael		DC_E0335		K.2.2
Jeffries	Michael		DC_M0615		K.2.1
Jeffries	Michael		DC_M6763	UCS	K.2.1
Jeffries	Sherry		DC_M5875	UCS	K.2.1
Jelic	John		DC_M7320	UCS	K.2.1
Jelinek	Alexander		DC_M5320	UCS	K.2.1
Jelinek	Alexander		DC_M5899	UCS	K.2.1
Jenkens	Jesslyn		DC_M2281	UCS	K.2.1
Jenkins	Bonnie		DC_M5849	UCS	K.2.1
Jenkins	John L.		DC_M7465	UCS	K.2.1
Jenkins	Jon		DC_M0562		K.2.1
Jenkins	Michael		DC_E0360		K.3.9
Jennetten	Paul		DC_M3487	UCS	K.2.1
Jennings	Mary Alice		DC_M3902	UCS	K.2.1
Jensen	Kristina		DC_M5389	UCS	K.2.1
Jensen	Pamela		DC_M5611	UCS	K.2.1
Jenson	Paula		DC_M6110	UCS	K.2.1
Jerman	Kathy		DC_M3586	UCS	K.2.1
Jett	Marshall		DC_M2023	UCS	K.2.1
Ji	Angela		DC_M7598	UCS	K.2.1
Jijon	Humberto		DC_M7192	UCS	K.2.1
Jimenez	Salvador		DC_M5059	UCS	K.2.1
Jine	Karen		DC_M3257	UCS	K.2.1

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Jirles	Bill		DC_M0375		K.2.1
Joel	Kenneth		DC_M0195		K.3.2, K.3.14
Joerg	John		DC_M0445		K.2.1
Joffrain	Abigail		DC_M6096	UCS	K.2.1
Johannesen	Amy		DC_M6027	UCS	K.2.1
Johannesen	Amy		DC_M3225	UCS	K.2.1
Johannesen	Joahn		DC_M6571	UCS	K.2.1
John	Helen		DC_E0388	Womenwith Hill Women's Peace Campaign	K.3.4, K.3.5, K.3.6, K.3.11, K.3.11, K.3.12, K.3.15
Johns	Patrick		DC_M4934	UCS	K.2.1
Johnson	Ashley		DC_M3670	UCS	K.2.1
Johnson	Audrey		DC_M6347	UCS	K.2.1
Johnson	Ava-Dale		DC_M0113		K.3.2, K.3.3, K.3.4, K.3.7, K.3.11, K.3.12, K.3.15
Johnson	B		DC_M4460	UCS	K.2.1
Johnson	Brenda		DC_E0119	USGS	K.3.9
Johnson	Coriella		DC_M3026	UCS	K.2.1
Johnson	Donald W.		DC_M4493	UCS	K.2.1
Johnson	Douglas C.		DC_M0510		K.2.1
Johnson	Heidi		DC_M6659	UCS	K.2.1
Johnson	James		DC_M2766	UCS	K.2.1
Johnson	Janet		DC_M6193	UCS	K.2.1
Johnson	Janice		DC_M1924	UCS	K.2.1
Johnson	Jillian		DC_M5335	UCS	K.2.1
Johnson	Julie		DC_M6145	UCS	K.2.1
Johnson	Kersten		DC_M2927	UCS	K.2.1
Johnson	Lisa		DC_M3945	UCS	K.2.1
Johnson	Mary L.		DC_M6428	UCS	K.2.1
Johnson	Michael		DC_M5669	UCS	K.2.1
Johnson	Nancy		DC_M6830	UCS	K.2.1
Johnson	Nancy		DC_M6831	UCS	K.2.1
Johnson	Nicole		DC_M6486	UCS	K.2.1
Johnson	Paul		DC_M2865	UCS	K.2.1
Johnson	R.E.		DC_M2509	UCS	K.2.1
Johnson	R.M.		DC_M3231	UCS	K.2.1
Johnson	Raymond		DC_M3416	UCS	K.2.1
Johnson	Ron		DC_M2358	UCS	K.2.1
Johnson	Rose		DC_M0088		K.2.1
Johnson	Steve		DC_M7866		K.2.1
Johnson	Susan		DC_M5804	UCS	K.2.1
Johnson	Virginia		DC_M3339	UCS	K.2.1
Johnson	Joann		DC_M1430	UCS	K.2.1
Johnson-Grim	Anne		DC_M1397	UCS	K.2.1
Johnsrud	Robert		DC_E0350		K.3.3, K.3.12, K.3.13, K.3.15
Johnston	Ardis		DC_M6300	UCS	K.2.1
Johnston	Matthew		DC_M4367	UCS	K.2.1
Johnston	Tom		DC_P0004		K.3.2, K.3.14
Jones	Ann		DC_M2625	UCS	K.2.1
Jones	Ben		DC_M1561	UCS	K.2.1
Jones	Carole		DC_M2630	UCS	K.2.1
Jones	Cathleen		DC_M5794	UCS	K.2.1
Jones	Chris		DC_M4755	UCS	K.2.1
Jones	David H.		DC_M5188	UCS	K.2.1
Jones	Dayvid		DC_M1689	UCS	K.2.1
Jones	Eric		DC_M4593	UCS	K.2.1
Jones	Gwyneth		DC_M4671	UCS	K.2.1
Jones	Janna		DC_M5071	UCS	K.2.1
Jones	Jeff		DC_M1190	UCS	K.2.1

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Jones	Jeffrey		DC_M3390	UCS	K.2.1
Jones	Jeri		DC_M5791	UCS	K.2.1
Jones	Joan		DC_M3587	UCS	K.2.1
Jones	Judy		DC_M4712	UCS	K.2.1
Jones	Katherine		DC_M7095	UCS	K.2.1
Jones	Linda		DC_M7213	UCS	K.2.1
Jones	Mary		DC_M4780	UCS	K.2.1
Jones	Melissa		DC_M3397	UCS	K.2.1
Jones	Michael		DC_E0001		K.3.9
Jones	Michael		DC_E0023		K.3.9
Jones	Michael		DC_E0162	Department of Physics and Astronomy, Univ. of Hawaii	K.4
Jones	Michael		DC_PHO0044		K.4
Jones	Nicholas		DC_M1653	UCS	K.2.1
Jones	Rebecca		DC_M2282	UCS	K.2.1
Jones	Ruth F.		DC_M4969	UCS	K.2.1
Jones	Sandra		DC_M6638	UCS	K.2.1
Jones	Wendy		DC_M2003	UCS	K.2.1
Jongsma	Jonathon		DC_M5683	UCS	K.2.1
Jonkel	George		DC_M0201		K.3.10, K.3.14
Jordan	Ava		DC_M0156		K.2.2
Jordan	Callie		DC_M6546	UCS	K.2.1
Jordan	Lawrence		DC_M5174	UCS	K.2.1
Jordan	Michael		DC_M1624	UCS	K.2.1
Jordan	Nancy		DC_M6113	UCS	K.2.1
Jordan	Pete		DC_M0182		K.2.1
Jordan	Susan		DC_M4808	UCS	K.2.1
Jorgensen	James H		DC_M0545		K.2.1
Jorgenson	Rhodie		DC_M3278	UCS	K.2.1
Jorissen	Robert		DC_M0792	UCS	K.2.1
Jorstad	Jon		DC_M2273	UCS	K.2.1
Joseph	Nathan		DC_M4511	UCS	K.2.1
Josephs	Emmy	Clark Josephs	DC_M5492	UCS	K.2.1
Joshua	Sophia		DC_M1696	UCS	K.2.1
Joslin	David		DC_E0045		K.3.1, K.3.7, K.3.15
Jossi	Lynn		DC_M7888		K.3.2, K.3.3, K.3.7, K.3.10, K.3.14
Joyce	Patricia		DC_M4345	UCS	K.2.1
Juckes	Pauline		DC_M6550	UCS	K.2.1
Jud	Daniel		DC_M5319	UCS	K.2.1
Judd	Floyd		DC_E0065		K.3.8
Judge	Jane		DC_M6481	UCS	K.2.1
Judge	Steven		DC_M7536	UCS	K.2.1
Judson	Arnold		DC_E0124		K.3.1, K.3.3, K.3.14
Judson	Charles		DC_E0156		K.3.13, K.3.14
Judson	Sarah		DC_M4601	UCS	K.2.1
Judy	Randolph		DC_M4781	UCS	K.2.1
Julien	Lorraine		DC_E0311		K.3.1, K.3.2, K.3.10, K.3.11, K.3.15
Jurash	Andrew		DC_M3142	UCS	K.2.1
Juricic	Marilyn		DC_M2463	UCS	K.2.1
Jurkowski	Janine		DC_M4846	UCS	K.2.1
Jury	Elissa		DC_E0113		K.3.2, K.3.3, K.3.4, K.3.7, K.3.10, K.3.12, K.3.15
Just	Margaret		DC_M1913	UCS	K.2.1
Justen	Kathy		DC_M5317	UCS	K.2.1
Justesen	Evy		DC_M4242	UCS	K.2.1

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Justice	Sivita		DC_M2019	UCS	K.2.1
K	Doug		DC_M3553	UCS	K.2.1
K	Raquel		DC_M6045	UCS	K.2.1
K.	Laura		DC_M5069	UCS	K.2.1
Kadas	Linda		DC_M3261	UCS	K.2.1
Kaeser	Anne		DC_M6842	UCS	K.2.1
Kafkaloff	John		DC_M0907	UCS	K.2.1
Kahan	D.		DC_M3503	UCS	K.2.1
Kahl	Kim		DC_M3793	UCS	K.2.1
Kahle	Joyce		DC_M6336	UCS	K.2.1
Kahn	Eva M.		DC_M5109	UCS	K.2.1
Kahn	Jerome		DC_M7752		K.2.3
Kahn	Peter		DC_M3777	UCS	K.2.1
Kairys	Howard		DC_M2964	UCS	K.2.1
Kajihiro	Kyle		DC_E0008		K.3.9
Kajihiro	Kyle		DC_PHO0046	American Friends Service Committee	K.3.1, K.3.3, K.3.4, K.3.11, K.4
Kalbtleisch	George		DC_M7924		K.2.1
Kalicki	John		DC_M4392	UCS	K.2.1
Kalovsky	Robert		DC_M4094	UCS	K.2.1
Kaluzynski	Thomas		DC_M0196		K.3.7, K.3.11, K.3.12, K.3.15
Kalven	Janet		DC_M0910	UCS	K.2.1
Kamath	Tara		DC_M5898	UCS	K.2.1
Kameya	Patti		DC_M7448	UCS	K.2.1
Kamin	Russell		DC_M1059	UCS	K.2.1
Kaminsky	Jason		DC_M3939	UCS	K.2.1
Kamke	Jay		DC_M7209	UCS	K.2.1
Kammer	Marjorie		DC_M0016		K.3.1, K.3.4, K.3.6, K.3.10, K.3.11, K.3.12
Kandel	Cheryl		DC_M1764	UCS	K.2.1
Kandell	Paul		DC_M7557	UCS	K.2.1
Kane	Ailene		DC_M1096	UCS	K.2.1
Kane	John		DC_M0589		K.2.1
Kane	Joseph		DC_M4020	UCS	K.2.1
Kane	Sherman		DC_M4945	UCS	K.2.1
Kaneko	Sabine		DC_M1333	UCS	K.2.1
Kang	Betty		DC_M5163	UCS	K.2.1
Kannappan	Sheila		DC_M5743	UCS	K.2.1
Kanoff	Alexandra		DC_M6013	UCS	K.2.1
Kapan	Eric		DC_M2621	UCS	K.2.1
Kaplan	Jessica		DC_M0752		K.2.1
Kaplan	Robert B.		DC_M2765	UCS	K.2.1
Kaplan	Sarah		DC_M6798	UCS	K.2.1
Kapral	Olga		DC_M3751	UCS	K.2.1
Kapral	Olga		DC_M3754	UCS	K.2.1
Kardiak	Jennifer		DC_M2074	UCS	K.2.1
Karl	Jason		DC_M2797	UCS	K.2.1
Karlin	Tyler		DC_M2610	UCS	K.2.1
Karnowski	Sandi		DC_M1229	UCS	K.2.1
Karnowski	Sandi		DC_M2122	UCS	K.2.1
Karp	Michael		DC_M6700	UCS	K.2.1
Karp	Xantha		DC_M6944	UCS	K.2.1
Karpen	Leah		DC_M0017		K.3.1, K.3.2, K.3.3, K.3.6, K.3.7, K.3.10, K.3.13, K.3.15
Kasebier	Tracy		DC_M6009	UCS	K.2.1
Kaselow	Frederick		DC_M3926	UCS	K.2.1
Kaser	Ruth		DC_E0441		K.3.1, K.3.2, K.3.4, K.3.14
Kasper	Alexa		DC_M0030		K.3.4, K.3.11, K.3.12
Kasper	Ed		DC_M5295	UCS	K.2.1

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Kasper	James		DC_M7023	UCS	K.2.1
Kass	Jamie		DC_M3907	UCS	K.2.1
Kasten	Christine		DC_M5893	UCS	K.2.1
Kastern	William		DC_M3678	UCS	K.2.1
Kaszas	Jayne		DC_M4523	UCS	K.2.1
Katch	Jed		DC_M7705		K.2.1
Kateiva	Alberta		DC_M5710	UCS	K.2.1
Kathleen	Wroblewski		DC_M3388	UCS	K.2.1
Katten	DC		DC_M2863	UCS	K.2.1
Katten	DC		DC_M5967	UCS	K.2.1
Katz	Fern		DC_E0141		K.2.2
Katz	Sondra		DC_M3264	UCS	K.2.1
Katzenmeyer			DC_M3980	UCS	K.2.1
Katzenstein	Robin		DC_M7591	UCS	K.2.1
Katzin	William		DC_M3577	UCS	K.2.1
Kauffman	Caryn		DC_M5850	UCS	K.2.1
Kaufman	Katherine		DC_M1428	UCS	K.2.1
Kaufmann	Gina		DC_M0565		K.2.1
Kausher	Carol Y.		DC_M1833	UCS	K.2.1
Kay	Candace		DC_M2126	UCS	K.2.1
Kay	David		DC_M6455	UCS	K.2.1
Kay	Joni		DC_M3230	UCS	K.2.1
Kay	Sasha		DC_M6085	UCS	K.2.1
Kaye	Diana		DC_M1034	UCS	K.2.1
Kaymen	Scott		DC_M5151	UCS	K.2.1
Kayser	Roland		DC_M5730	UCS	K.2.1
Kayyal	Amjad		DC_M5220	UCS	K.2.1
Kean	Martha		DC_M4669	UCS	K.2.1
Kearns	D.		DC_M7220	UCS	K.2.1
Kearns	Sandy		DC_M6452	UCS	K.2.1
Keating	Katherine		DC_M1043	UCS	K.2.1
Keating-Secular	Karen		DC_M2798	UCS	K.2.1
Keech	Helen Cecelia		DC_M4068	UCS	K.2.1
Keefe	Frankie		DC_M4043	UCS	K.2.1
Keefe	Meghan		DC_M2238	UCS	K.2.1
Keefer	Julie D		DC_M2180	UCS	K.2.1
Keefer	Julie D.		DC_M7470	UCS	K.2.1
Keefer	Julie D.		DC_M7472	UCS	K.2.1
Keefer	Kristine		DC_M1813	UCS	K.2.1
Keeley	Diane		DC_M2200	UCS	K.2.1
Kee-Manon	Dylan		DC_M2506	UCS	K.2.1
Keenan	Tajha		DC_M1623	UCS	K.2.1
Keenan	Thomas D		DC_M3108	UCS	K.2.1
Keene	Margo		DC_M0190		K.2.1
Keene	Paul		DC_M3759	UCS	K.2.1
Keeney	Sharon		DC_M4481	UCS	K.2.1
Keeton	Dewey		DC_M6355	UCS	K.2.1
Keim	Anna		DC_M1319	UCS	K.2.1
Keitelman	Mary		DC_M3080	UCS	K.2.1
Keith	Novella		DC_M4431	UCS	K.2.1
Kekoolani	Terri		DC_PHO0051		K.3.1, K.3.4, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Kelleher	Stephen		DC_M5234	UCS	K.2.1
Keller	Charlotte		DC_M5053	UCS	K.2.1
Keller	Jill		DC_M3554	UCS	K.2.1
Keller	Nathan		DC_M3341	UCS	K.2.1
Keller	Robert E.		DC_M3410	UCS	K.2.1
Keller	William		DC_M1207	UCS	K.2.1
Keller	Wynne		DC_M5583	UCS	K.2.1

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Kelley	Pam		DC_M0382		K.2.1
Kellogg	David		DC_M0834	UCS	K.2.1
Kellogg	Lorie B.		DC_M5215	UCS	K.2.1
Kelly	Alice		DC_M6086	UCS	K.2.1
Kelly	Anne		DC_E0343		K.3.4, K.3.13, K.3.15, K.4
Kelly	Barbara		DC_M3798	UCS	K.2.1
Kelly	Jeannie		DC_M4379	UCS	K.2.1
Kelly	Lee Anna		DC_M2738	UCS	K.2.1
Kelly	Mary		DC_M1293	UCS	K.2.1
Kelly	Paula		DC_M6436	UCS	K.2.1
Kelting	Michael		DC_M4203	UCS	K.2.1
Keltner	Jeanie		DC_PHO0022		K.4
Kendy	Diane		DC_M6240	UCS	K.2.1
Kennard	Kimberly		DC_M6506	UCS	K.2.1
Kennedy	Brenda		DC_M2201	UCS	K.2.1
Kennedy	Janet		DC_E0414		K.3.2, K.3.3, K.3.4, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15
Kennedy	Jason		DC_M0595		K.2.1
Kennedy	Joan		DC_M7121	UCS	K.2.1
Kennedy	JoAnn C		DC_M2801	UCS	K.2.1
Kennedy	Kate		DC_PHW0010	Veterans for Peace, Womens International League for Peace and Freedom, Peace Action	K.3.2, K.3.4, K.3.5, K.3.11, K.3.12
Kennedy	Leslie		DC_M1946	UCS	K.2.1
Kennedy	Sara		DC_M6922	UCS	K.2.1
Kennedy	Susan		DC_F0006	NOAA	K.5
Kennedy	Tom		DC_M6255	UCS	K.2.1
Kennedy	V.J		DC_F0004		K.3.13, K.3.15, K.4
Kennedy	Vernon		DC_E0157		K.3.1, K.3.2, K.3.3, K.3.5
Kennedy	Vicky Jo		DC_P0002		K.3.9
Kennedy	Vicky Jo		DC_P0006		K.3.9
Kennedy	Vicky Jo		DC_P0012		K.3.9
Kenney	Alison		DC_M6507	UCS	K.2.1
Kenney	Anne		DC_M6646	UCS	K.2.1
Kenney	Stepahnie		DC_M7474	UCS	K.2.1
Kenny	James A.		DC_M0487		K.2.1
Kenny	Robert		DC_E0316		K.2.2
Kent	Margaret		DC_M6868	UCS	K.2.1
Keough	Kurt		DC_M5837	UCS	K.2.1
Kern	Alicia		DC_M6052	UCS	K.2.1
Kern	Marcia		DC_M7636	UCS	K.2.1
Kerner	Jeremy		DC_M6328	UCS	K.2.1
Kerr	Barbara		DC_M6551	UCS	K.2.1
Kerr	Danielle		DC_M2590	UCS	K.2.1
Kerr	Dr. D.		DC_M1841	UCS	K.2.1
Kessler	Irene		DC_M5557	UCS	K.2.1
Kessler	Laura N.		DC_M5147	UCS	K.2.1
Kessler	Micheal		DC_M2489	UCS	K.2.1
Kessler	Stuart		DC_M3677	UCS	K.2.1
Kester	Donald		DC_M5154	UCS	K.2.1
Kestler	Carol S.		DC_M5470	UCS	K.2.1
Kestler	Ronald		DC_M5584	UCS	K.2.1
Ketels	Shaw		DC_M5110	UCS	K.2.1
Ketels	Shaw		DC_M7599	UCS	K.2.1
Keuler	Rachel		DC_M4288	UCS	K.2.1
Kever	Jeanne		DC_M4666	UCS	K.2.1

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Keyes	Larry	Peg Keyes	DC_M1343	UCS	K.2.1
Khairandish	Mohi		DC_M0344		K.2.1
Khalil	Mary		DC_M0369		K.2.1
Khalil	Suzanne		DC_M3696	UCS	K.2.1
Khalsa	Hari Mandir Kaur		DC_M0639		K.2.1
Khalsa	Mha Atma Singh		DC_M0035		K.2.1
Khalsa	Santokh Singh	Suraj Kaur Khalsa	DC_M0075		K.2.1
Khalsa	Shanti Shanit Kaur		DC_M0118		K.2.1
Khamzang			DC_M3133	UCS	K.2.1
Khan	Dina		DC_M6502	UCS	K.2.1
Kibitz	Gregory D.		DC_M3551	UCS	K.2.1
Kidder	KD		DC_M3625	UCS	K.2.1
Kiehl	Renate		DC_M6834	UCS	K.2.1
Kihn	Mitch		DC_M4615	UCS	K.2.1
Kilborn	Adam		DC_M3807	UCS	K.2.1
Kilcrease	Terry		DC_M1206	UCS	K.2.1
Kilduff	Katherine		DC_M6640	UCS	K.2.1
Kilimas	Christie		DC_M5949	UCS	K.2.1
Killay	Sharon		DC_M4813	UCS	K.2.1
Killinger	Deb		DC_M4742	UCS	K.2.1
Kim	Jennifer		DC_M6517	UCS	K.2.1
Kim	Tiffany		DC_M6516	UCS	K.2.1
Kimball	Deborah		DC_E0242		K.3.1, K.3.4, K.3.13, K.3.14, K.3.15
Kimber	David		DC_M7175	UCS	K.2.1
Kimble	Dawn		DC_M0936	UCS	K.2.1
Kimmich	Scott		DC_M3719	UCS	K.2.1
Kimple	J.D.		DC_M5213	UCS	K.2.1
Kincaid	Colli		DC_M0077		K.2.1
Kincaide	Delores		DC_E0293		K.3.2, K.3.3, K.3.4, K.3.7, K.3.11, K.3.13, K.3.15
Kincses	Robert		DC_M3497	UCS	K.2.1
King	Christopher		DC_M3326	UCS	K.2.1
King	David		DC_M1745	UCS	K.2.1
King	Donna		DC_E0101		K.3.2, K.3.11, K.3.13
King	Jennifer		DC_M5128	UCS	K.2.1
King	Natalie		DC_M1648	UCS	K.2.1
Kingsbury	Maxine		DC_M3613	UCS	K.2.1
Kingsnorth	Neil		DC_E0387	Yorkshire Campaign for Nuclear Disarmament	K.3.2, K.3.3, K.3.4, K.3.5, K.3.6, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Kingston	John		DC_M2663	UCS	K.2.1
Kinkead	Sheila		DC_M2547	UCS	K.2.1
Kinn	Joan		DC_M7507	UCS	K.2.1
Kippling	David		DC_M7711		K.2.1
Kiralla	Michael		DC_M3961	UCS	K.2.1
Kirby	Douglas		DC_M1140	UCS	K.2.1
Kirby	Laurence		DC_F0002		K.2.2
Kirby	Laurence		DC_M0256		K.2.2
Kirch	Jan		DC_M1400	UCS	K.2.1
Kirchenbauer	Maryann		DC_M1835	UCS	K.2.1
Kirchhof	Joe		DC_M7545	UCS	K.2.1
Kirchhoff	Richard		DC_M6685	UCS	K.2.1
Kirchner	John		DC_M4299	UCS	K.2.1
Kirchner	Michael		DC_M3951	UCS	K.2.1
Kirk	Edgar		DC_M6560	UCS	K.2.1
Kirk	Karisha		DC_M2726	UCS	K.2.1

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Kirk	Ruth		DC_M0225		K.2.2
Kirkconnell	Robert		DC_M3134	UCS	K.2.1
Kirkwood	Anne		DC_M3024	UCS	K.2.1
Kirschner	Jonathan		DC_M2763	UCS	K.2.1
Kislock	Stephen F.		DC_M3585	UCS	K.2.1
Kissam	Sandra		DC_M3861	UCS	K.2.1
Kissler	Kenneth F.		DC_M0337		K.2.1
Kistler	Suzanne		DC_P0008		K.2.2
Kistler	Suzanne F.		DC_M1355	UCS	K.2.1
Kistner	Carrie		DC_M7212	UCS	K.2.1
Kitti	Teri		DC_M5490	UCS	K.2.1
Kittrell	Jeff		DC_M5905	UCS	K.2.1
Kjolseth	Rolf		DC_E0089		K.3.1, K.3.13
Kjonass	Raechel		DC_M3466	UCS	K.2.1
Klatt	Dana		DC_M0426		K.2.1
Kleckner	Kathryn		DC_M2261	UCS	K.2.1
Klein	Alison		DC_M7170	UCS	K.2.1
Klein	David		DC_M7903		K.3.4, K.3.5, K.3.7, K.3.10, K.3.11, K.3.13, K.3.14, K.3.15, K.4
Klein	Michael		DC_M7578	UCS	K.2.1
Klein	Pam		DC_M2024	UCS	K.2.1
Klein	William		DC_M3779	UCS	K.2.1
Kleiss	Lee Maria		DC_M2579	UCS	K.2.1
Klesh	Jennifer		DC_M3348	UCS	K.2.1
Kleshinski	Frank X.		DC_M3888	UCS	K.2.1
Kleyman	Alexandra		DC_M0540		K.2.1
Kligman	Philip S.		DC_M4163	UCS	K.2.1
Kline	Laree		DC_M0979	UCS	K.2.1
Kline	Paula		DC_M6906	UCS	K.2.1
Kline	Peter		DC_M1867	UCS	K.2.1
Klinger	Roderick		DC_M1782	UCS	K.2.1
Klitgord	Niels		DC_M5978	UCS	K.2.1
Klohr	Antonia		DC_M3561	UCS	K.2.1
Klonin	Hilary		DC_E0031		K.2.2
Klos	Tracy		DC_M6213	UCS	K.2.1
Klosterman	Michelle		DC_M4046	UCS	K.2.1
Knapp	Eva		DC_M4218	UCS	K.2.1
Knapp	Leah		DC_M0299		K.2.1
Knapp	Regina		DC_M3866	UCS	K.2.1
Kneece	Angela		DC_M6780	UCS	K.2.1
Knese	Greg		DC_M7438	UCS	K.2.1
Kness	Alena		DC_M7195	UCS	K.2.1
Knight	Paige		DC_E0186	Hanford Watch	K.3.2, K.3.3, K.3.4, K.3.10, K.3.11, K.3.13, K.3.15, K.4
Knight	Paige		DC_M3674	UCS	K.2.1
Knight	Sue		DC_M4023	UCS	K.2.1
Knoll	Kristie		DC_M0157		K.2.1
Knott	Esther		DC_M0321		K.2.1
Knowles	Nancy		DC_M1019	UCS	K.2.1
Knox	Lynne		DC_M5125	UCS	K.2.1
Knox	Rand		DC_M3092	UCS	K.2.1
Knudson	Robert		DC_M2681	UCS	K.2.1
Knuth	C		DC_E0094	Center for Environmental Education	K.3.11, K.3.12
Knuth	C		DC_E0100		K.3.18
Knuth	C		DC_E0107		K.3.18
Knutsen	Leif		DC_M0736		K.2.1

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Knutsen	Leif		DC_M3604	UCS	K.2.1
Knutson	Alice		DC_M3431	UCS	K.2.1
Kochert	Marlene		DC_M1695	UCS	K.2.1
Koehler	Frank		DC_M4196	UCS	K.2.1
Koehler	Nancy		DC_M7339	UCS	K.2.1
Koenig	James		DC_M2700	UCS	K.2.1
Koester	Gisela		DC_M0166		K.3.14
Koester	Shawn		DC_M2973	UCS	K.2.1
Koetzle	Thomas		DC_M1168	UCS	K.2.1
Kogan	Robert		DC_M2980	UCS	K.2.1
Koger	Susan		DC_E0363		K.3.11, K.3.13, K.3.15, K.4
Kohler	John		DC_M3177	UCS	K.2.1
Kohler	John F.		DC_M5238	UCS	K.2.1
Kohler	Julilly		DC_M2159	UCS	K.2.1
Kohler	Kit		DC_M3640	UCS	K.2.1
Kohler	Melissa		DC_M2041	UCS	K.2.1
Kohn	Jeremy		DC_M7843		K.3.17
Kohn	Marilyn		DC_M0050		K.2.1
Kohn	Steve		DC_M3440	UCS	K.2.1
Kohn	Walter		DC_M4022	UCS	K.2.1
Kok	Terry Ryan		DC_M4869	UCS	K.2.1
Kolarik	John		DC_M3407	UCS	K.2.1
Kolin	April		DC_M2687	UCS	K.2.1
Kolinski	Mark		DC_M5101	UCS	K.2.1
Koller	S.l.		DC_M5767	UCS	K.2.1
Konigsbauer	Kathleen		DC_M5306	UCS	K.2.1
Konopaski	Bud and Judy		DC_M2283	UCS	K.2.1
Konopaski	Kirsten		DC_M2245	UCS	K.2.1
Kontje	Claire		DC_M6325	UCS	K.2.1
Kooi	Steven		DC_M4225	UCS	K.2.1
Koon	Teresa		DC_M1121	UCS	K.2.1
Koonmen	Marie Aimee		DC_E0358		K.2.4
Kopicki	Susan		DC_E0055		K.3.1, K.3.3, K.3.5, K.3.6, K.3.11, K.3.12
Kopizke	Mary		DC_M7231	UCS	K.2.1
Kopnick	Donna		DC_E0090		K.2.2
Kopolow	John		DC_M4534	UCS	K.2.1
Kopp	Chad		DC_M6518	UCS	K.2.1
Kopp	Helen		DC_M6050	UCS	K.2.1
Koprak	Sam		DC_M4611	UCS	K.2.1
Koralja	Jason		DC_M2778	UCS	K.2.1
Korb	George		DC_M6760	UCS	K.2.1
Korbel	Kate		DC_M5117	UCS	K.2.1
Korbel	Kate		DC_M7534	UCS	K.2.1
Korte	Mary		DC_M5839	UCS	K.2.1
Kortge	Walter		DC_M6352	UCS	K.2.1
Kosacz	Nicole		DC_M6070	UCS	K.2.1
Kosek	John		DC_M1250	UCS	K.2.1
Kosek	Raphael		DC_M2037	UCS	K.2.1
Kosuda	Joseph		DC_M7774		K.2.1
Kotka	Keith		DC_M0360		K.2.1
Kotta	Paul A.		DC_M2899	UCS	K.2.1
Kotula	Joseph		DC_M1950	UCS	K.2.1
Koumoutseas	Katherine		DC_M5311	UCS	K.2.1
Kourkoumelis	C		DC_M5126	UCS	K.2.1
Kovack	Michelle		DC_M5561	UCS	K.2.1
Kovacs	Micheal		DC_M3288	UCS	K.2.1
Koval	Jason		DC_M5788	UCS	K.2.1
Kowal	Robert		DC_M1216	UCS	K.2.1

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Kowaleski	Ann		DC_M7620	UCS	K.2.1
Kowalski	Victor		DC_M0507		K.2.1
Kowitt	T.		DC_M0364		K.2.1
Kowitt	T.		DC_M0376		K.2.1
Kozaka	Josef		DC_M5869	UCS	K.2.1
Kozanli	A.N.		DC_M2818	UCS	K.2.1
Kozisek	Summer		DC_M2140	UCS	K.2.1
Kozlowicz	Kelvin	Emily Kozlowicz	DC_M6792	UCS	K.2.1
Kozlowski	David		DC_M7313	UCS	K.2.1
Kozlowski	Thaddeus P		DC_M2051	UCS	K.2.1
Kozub	John		DC_M0346		K.2.1
Kraan	Aletta		DC_M4100	UCS	K.2.1
Kraatz	Monica		DC_M5778	UCS	K.2.1
Krach	Judy		DC_M0635		K.2.1
Kraegenbrink	Melody		DC_M4510	UCS	K.2.1
Krajec	Edward		DC_M6339	UCS	K.2.1
Kramer	David		DC_M7262	UCS	K.2.1
Krane	Ben		DC_M1452	UCS	K.2.1
Krasney	Mitchell		DC_M7662	UCS	K.2.1
Kraszewski	Chester		DC_M5641	UCS	K.2.1
Kraus	Rhoda		DC_M5326	UCS	K.2.1
Krause	Al		DC_M3081	UCS	K.2.1
Krause	Judy		DC_M3909	UCS	K.2.1
Krauss	Roland		DC_M3458	UCS	K.2.1
Krautheim	Raymond		DC_M3845	UCS	K.2.1
Kray	Gina		DC_M3994	UCS	K.2.1
Kreamer	Bill		DC_M2400	UCS	K.2.1
Kreider	Nancy		DC_M6376	UCS	K.2.1
Kremer	Karen		DC_M2539	UCS	K.2.1
Kremer	Karen		DC_M4839	UCS	K.2.1
Kremer-Collins	Karen		DC_M7120	UCS	K.2.1
Kreml	Liz		DC_M6999	UCS	K.2.1
Krems	Susan		DC_M3188	UCS	K.2.1
Kress	Marin		DC_M6826	UCS	K.2.1
Kreutz	Eileen		DC_M4435	UCS	K.2.1
Krezdorn	Roxanne M.		DC_M1103	UCS	K.2.1
Kriby	Stephen		DC_M5700	UCS	K.2.1
Kriesel	Jason		DC_M7758		K.3.7, K.3.10, K.3.11, K.3.13, K.3.14
Kristel	Todd		DC_M7865		K.2.1
Krizanich	Annette		DC_M3111	UCS	K.2.1
Krmaer	Sheryl		DC_M4222	UCS	K.2.1
Krolikowski	Helena		DC_M6463	UCS	K.2.1
Kroll	Kathryn		DC_M1568	UCS	K.2.1
Kronika	Jessica		DC_M1576	UCS	K.2.1
Kropf	John		DC_M1391	UCS	K.2.1
Krotser	Donald		DC_E0147		K.3.2
Kroupa	Brenda		DC_M2105	UCS	K.2.1
Krous	Constance		DC_M4533	UCS	K.2.1
Krueger	Evelyn		DC_E0140		K.3.2, K.3.10, K.3.13, K.3.14
Krueger	Shelly		DC_M7006	UCS	K.2.1
Kruger	Amy		DC_M1040	UCS	K.2.1
Krupp	Catharine		DC_M3260	UCS	K.2.1
Kruse	Mary Ann		DC_M2236	UCS	K.2.1
Krzmarzick	Jim		DC_M7918		K.3.1, K.3.2, K.3.3, K.3.4, K.3.10, K.3.11, K.3.12
Kubiak	Arnie		DC_M5589	UCS	K.2.1
Kucera	Renee		DC_M2314	UCS	K.2.1
Kuetzing	Karl		DC_M4770	UCS	K.2.1

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Kugland	Nathan		DC_M6968	UCS	K.2.1
Kugler	Peter		DC_M3809	UCS	K.2.1
Kugler	Tony		DC_M6611	UCS	K.2.1
Kulcsar	Michael		DC_M6088	UCS	K.2.1
Kunkel	Christopher R.		DC_M0094		K.2.1
Kunkel	Michael		DC_M6874	UCS	K.2.1
Kuramoto	Sue		DC_M3138	UCS	K.2.1
Kurihara	Chiaki		DC_M4438	UCS	K.2.1
Kuroczka	Justine		DC_M2381	UCS	K.2.1
Kurowski	Bryan		DC_M2597	UCS	K.2.1
Kuruc	Karol		DC_M2532	UCS	K.2.1
Kurz	Robert		DC_M4661	UCS	K.2.1
Kusko	Elizabeth		DC_M2804	UCS	K.2.1
Kutzer	Norma		DC_M5578	UCS	K.2.1
Kuzin	James		DC_M7363	UCS	K.2.1
Kwan	Dory		DC_M4240	UCS	K.2.1
Kwon	Brenda		DC_E0382		K.2.3
Kyger-Liskey	Margaret		DC_M2908	UCS	K.2.1
Kyser	Angela		DC_M2335	UCS	K.2.1
L	E		DC_M6064	UCS	K.2.1
La Freniere	Cher Louise		DC_M0387		K.2.1
La Rosa	Frank		DC_M4568	UCS	K.2.1
Laben	Bill		DC_P0001		K.3.2, K.3.3, K.3.10, K.3.13
Labonte	Emmy		DC_M7874		K.2.1
LaBonte	Heather		DC_M0626		K.2.1
LaBonte	Heather		DC_M2346	UCS	K.2.1
Labriola	Kathy		DC_M0004		K.3.2, K.3.4, K.3.7, K.3.10, K.3.12, K.3.15
LaBruna	Victor		DC_M3680	UCS	K.2.1
Lacey	Dave		DC_M3958	UCS	K.2.1
Lachman	Julie		DC_M0226		K.2.1
Lackey	Mercedes		DC_M7884		K.2.1
LaCognata	Dale		DC_M5956	UCS	K.2.1
LaCrosse	Guy		DC_M6231	UCS	K.2.1
LaDeur	Penny		DC_M2349	UCS	K.2.1
Ladson	Michael		DC_M1426	UCS	K.2.1
Ladson	Michael		DC_M6479	UCS	K.2.1
Laedlein	Shirley		DC_M4797	UCS	K.2.1
Laemle	Johanna		DC_M7826		K.2.1
Lafaver	Barbara		DC_M3216	UCS	K.2.1
Lafler	Tim		DC_M6420	UCS	K.2.1
Lafollete	Peter		DC_M0869	UCS	K.2.1
lafollete	Peter		DC_M5277	UCS	K.2.1
LaFreniere	Joanne		DC_M2373	UCS	K.2.1
LaGarde	James		DC_M0738		K.2.1
LaHaie	Andrew		DC_M4095	UCS	K.2.1
Lai	Chauyen		DC_E0075		K.3.18
Laino	V.		DC_M4935	UCS	K.2.1
Laiti	Jared		DC_M7409	UCS	K.2.1
Laitysnyder	Mark		DC_M4866	UCS	K.2.1
Lamas	Alex		DC_M2469	UCS	K.2.1
Lamb	Belinda		DC_M6971	UCS	K.2.1
Lambert	Betsy		DC_M1265	UCS	K.2.1
Lambert	John		DC_M0051		K.2.1
Lamborn	Suzanne		DC_E0123		K.3.2, K.3.3, K.3.10
Lammie	Deanna		DC_M1980	UCS	K.2.1
Lamp	Zena		DC_M3176	UCS	K.2.1
Lampman	Melissa J		DC_M2911	UCS	K.2.1
Lampman	Ralph		DC_M1282	UCS	K.2.1

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Lampson	Sue		DC_M6991	UCS	K.2.1
Lampton	Catherine		DC_M5360	UCS	K.2.1
Lancaster	Emily		DC_M2617	UCS	K.2.1
Lancaster	Katherine		DC_M2494	UCS	K.2.1
Landa	Joanne		DC_M7431	UCS	K.2.1
Landeen	Clint		DC_M5259	UCS	K.2.1
Landis	Dana		DC_M3412	UCS	K.2.1
Landis	Larry		DC_M4065	UCS	K.2.1
Landis	Phyllis		DC_M7104	UCS	K.2.1
Landon-Lane	Elizabeth		DC_M0158		K.2.1
Landry	Margo		DC_M0202		K.2.1
Lane	Alexa		DC_M0858	UCS	K.2.1
Lane	Earl	Sue Lane	DC_M4108	UCS	K.2.1
Lane	Michael		DC_M5427	UCS	K.2.1
Lang	Cynthia R.		DC_M4777	UCS	K.2.1
Lang	Susanna		DC_M5698	UCS	K.2.1
Langdon	Abby		DC_M0839	UCS	K.2.1
Lange	Rebecca		DC_M5753	UCS	K.2.1
Langley	Mark		DC_M0553		K.2.1
Langley	Mike		DC_M7239	UCS	K.2.1
Langreck	Lillia		DC_M0040		K.2.2
Langridge	Judith		DC_M6687	UCS	K.2.1
Langton	David		DC_M1560	UCS	K.2.1
Lanham	Phyllis		DC_M7308	UCS	K.2.1
Lanning	Irvin		DC_M4244	UCS	K.2.1
Lanphear	Nancy		DC_M1345	UCS	K.2.1
Lansdowne	Jerry		DC_M7897		K.2.3
Lanzman	Sarah		DC_M7511	UCS	K.2.1
Lardon	Cecile		DC_M0872	UCS	K.2.1
Larisch	Erich W.		DC_M0498		K.2.1
Larish	Erich W.		DC_M6457	UCS	K.2.1
Larkin	Kristi		DC_M0385		K.2.1
LaRoe	Be		DC_M5646	UCS	K.2.1
Larose	Stephan		DC_M1844	UCS	K.2.1
Larsen	David W.		DC_M1456	UCS	K.2.1
Larsen	Joyce		DC_M2774	UCS	K.2.1
Larsen	Sonja		DC_M5035	UCS	K.2.1
Larson	Gil		DC_M1225	UCS	K.2.1
Larson	Jay		DC_M2813	UCS	K.2.1
Larson	Kelly		DC_M2902	UCS	K.2.1
Larson	MaryAnn		DC_M7644	UCS	K.2.1
Larter	Steve		DC_M2673	UCS	K.2.1
Laskin	Diane		DC_M1601	UCS	K.2.1
Lasman	Sharon		DC_M5587	UCS	K.2.1
Lasoff	Edward		DC_M3042	UCS	K.2.1
Lassalle	Kennith		DC_M3914	UCS	K.2.1
Lastiri	Bob		DC_M2325	UCS	K.2.1
Latham	Janet A.		DC_M1917	UCS	K.2.1
Latzen	Jaymi		DC_M7776		K.2.1
Laubach	Jeffrey S.		DC_M4269	UCS	K.2.1
Lauber	Diane		DC_M7699		K.2.1
Lauder	Carley		DC_M5711	UCS	K.2.1
Lauderdale	Edith		DC_E0367		K.3.1, K.3.2, K.3.3, K.3.15
Lauria	Jeanette		DC_M2495	UCS	K.2.1
Laurie	Annie		DC_M7616	UCS	K.2.1
Lausell	Susan		DC_M6525	UCS	K.2.1
Lavee	Annina		DC_M0103		K.2.1
Laverty	Denise		DC_M3291	UCS	K.2.1
Lavigna	Jacqueline		DC_M4528	UCS	K.2.1

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Lavigna	Jacqueline		DC_M4529	UCS	K.2.1
Lavoie	Diane		DC_M2131	UCS	K.2.1
Law	Patricia		DC_M2561	UCS	K.2.1
Lawless	Thomas Rollie		DC_M5275	UCS	K.2.1
Lawrence	Carl		DC_M7114	UCS	K.2.1
Lawrence	Deron		DC_M4113	UCS	K.2.1
Lawrence	George		DC_M0119		K.3.1, K.3.3, K.3.5, K.3.10, K.3.13, K.3.14
Lawrence	Jack		DC_M4598	UCS	K.2.1
Lawrence	Kirk		DC_M6941	UCS	K.2.1
Lawrence	Mary		DC_M2957	UCS	K.2.1
Lawson	Mickey		DC_M0988	UCS	K.2.1
Layman	Dorothy		DC_M0206		K.3.14
Layton	Jean		DC_M1211	UCS	K.2.1
Le Cun	Isabelle		DC_M6249	UCS	K.2.1
Leach	Harold		DC_M1652	UCS	K.2.1
Leacock	Carolyn		DC_M6165	UCS	K.2.1
Leal	Karl		DC_M2574	UCS	K.2.1
Lean	DA		DC_M0373		K.2.1
Leaverton	Dan		DC_M6663	UCS	K.2.1
Leavitt-Pagaling	Patricia		DC_M0571		K.2.1
Lebherz	Herbert G.		DC_M5489	UCS	K.2.1
LeBlanc	David J.		DC_M4760	UCS	K.2.1
Lebo	Harlan		DC_M5060	UCS	K.2.1
Lechtanski	Cheryl		DC_M5507	UCS	K.2.1
LeClaire	Carol		DC_M0095		K.3.14
Ledain	Nicole		DC_M1502	UCS	K.2.1
Lederman	Aurora		DC_M2508	UCS	K.2.1
Lee	Anne		DC_E0347	Womenwith Hill Women's Peace Camp(aign)	K.3.1, K.3.2, K.3.11, K.3.12, K.3.15, K.4
Lee	Brian		DC_M6462	UCS	K.2.1
Lee	Brian		DC_M7030	UCS	K.2.1
Lee	GatheringGrass		DC_M7519	UCS	K.2.1
Lee	Houghton		DC_M6955	UCS	K.2.1
Lee	Jenn		DC_M5871	UCS	K.2.1
Lee	Michael		DC_M1564	UCS	K.2.1
Lee	Todd		DC_M4336	UCS	K.2.1
Leeper	Erik		DC_M3127	UCS	K.2.1
Leeper	Erik		DC_M6267	UCS	K.2.1
Lees	Susie		DC_M2987	UCS	K.2.1
Leffler	Meredith		DC_M0480		K.2.1
Leffmann	Paula		DC_M5044	UCS	K.2.1
Lefsky	Sara		DC_M5817	UCS	K.2.1
Leghart	Linda C.		DC_M3833	UCS	K.2.1
Lehman	Hugh		DC_M7804		K.2.3
Lehmann	Hilde		DC_M0059		K.2.1
Lehmer	Aaron		DC_M5769	UCS	K.2.1
Lehnhoff	Mark		DC_M3269	UCS	K.2.1
Leibman	George		DC_M1008	UCS	K.2.1
Leibowitz	Lynda		DC_M5591	UCS	K.2.1
Leicher	Dorothea		DC_M2217	UCS	K.2.1
Leiderman	Ryan		DC_M1860	UCS	K.2.1
Leifer	Lori		DC_M1139	UCS	K.2.1
Leighton	Andrew		DC_M0053		K.2.1
Leighton	Stephanie		DC_M7066	UCS	K.2.1
Leipzig	Laura		DC_M3547	UCS	K.2.1
Leisey	Monica		DC_M0913	UCS	K.2.1
Leiter	Maria		DC_M4415	UCS	K.2.1

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Leman	Craig		DC_E0136		K.3.4, K.3.5, K.3.11
Lemaster	Samma		DC_M5800	UCS	K.2.1
Leming	Jeff		DC_M3521	UCS	K.2.1
Lemmo	Elena		DC_M5162	UCS	K.2.1
Lemmon	Katherine		DC_M1272	UCS	K.2.1
Lempert	Bobbi		DC_M3252	UCS	K.2.1
Lenard	Jim		DC_M0270		K.3.14
Lengen	George		DC_M1340	UCS	K.2.1
Lenk	Joseph		DC_M7600	UCS	K.2.1
Lenny	Siegel		DC_PHO0004	Center for Public Environmental Oversight	K.4
Lenoir	Jane		DC_M7171	UCS	K.2.1
Lent	Jessica		DC_M4332	UCS	K.2.1
Leonard	Andrea		DC_M6651	UCS	K.2.1
Leonard	Barbara		DC_M7031	UCS	K.2.1
Leonard	John		DC_M1336	UCS	K.2.1
Leonard	Jonathan		DC_M6752	UCS	K.2.1
Leonard	Patrick		DC_M6852	UCS	K.2.1
Leonard	Patrick		DC_M6913	UCS	K.2.1
Lepori	Luca		DC_M5452	UCS	K.2.1
Lerman	Michelle		DC_M7263	UCS	K.2.1
Lerner	Albert		DC_M1635	UCS	K.2.1
Lerner	Michelle		DC_M6782	UCS	K.2.1
Lerner	Rachel		DC_M3107	UCS	K.2.1
LeSeure	Charles		DC_M3983	UCS	K.2.1
Lesh	Terry		DC_M2878	UCS	K.2.1
Lesko	Robert		DC_M5037	UCS	K.2.1
Lessans	Vicki		DC_M7434	UCS	K.2.1
Lessmann	Paul		DC_M3474	UCS	K.2.1
Lester	Gail		DC_M2334	UCS	K.2.1
Lette	Constance		DC_M0060		K.2.1
Lettini	Lois		DC_M2711	UCS	K.2.1
Lev	Marjorie		DC_M5908	UCS	K.2.1
Levasseur	Virginia		DC_M6781	UCS	K.2.1
Leventhal	Sallye		DC_M5428	UCS	K.2.1
Levin	Alan		DC_M0764		K.2.1
Levin	Brian		DC_M5706	UCS	K.2.1
Levin	Carol		DC_M6592	UCS	K.2.1
Levine	Michael		DC_M0504		K.2.1
Levine	Stephen		DC_M7722		K.2.3
Levitan	Ruth		DC_M4852	UCS	K.2.1
Levitt	Donna		DC_M5650	UCS	K.2.1
Levno	Rose Beth		DC_E0364	Anchorage Branch of Women's International League for Peace and Freedom, Physicians for Social Responsibility	K.3.1
Levy	Allen		DC_M3601	UCS	K.2.1
Levy	E.J.		DC_M5217	UCS	K.2.1
Levy	Galen		DC_M2445	UCS	K.2.1
Levy	Jill		DC_M4487	UCS	K.2.1
Levy	Natalee		DC_M3848	UCS	K.2.1
Levy	Stella		DC_PHO0029		K.3.12, K.4
Levy	Wendy		DC_M2499	UCS	K.2.1
Lewi	Jack		DC_M0061		K.2.1
Lewis	Anne		DC_M2897	UCS	K.2.1

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Lewis	Dick		DC_M7870		K.3.7, K.3.10
Lewis	Gail		DC_M2460	UCS	K.2.1
Lewis	Genevieve K.		DC_M4423	UCS	K.2.1
Lewis	Jessie		DC_M2328	UCS	K.2.1
Lewis	Marvin		DC_E0018		K.2.2
Lewis	Marvin		DC_E0428		K.3.1, K.3.2, K.3.10, K.3.12, K.3.15, K.4
Lewis	Mel		DC_M6947	UCS	K.2.1
Lewis	Russell		DC_M4988	UCS	K.2.1
Lewis	Suford		DC_M7795		K.2.1
Lewis	Tonya		DC_M1107	UCS	K.2.1
Lewitzky	David		DC_M0670		K.2.1
Leyrer	Sarah		DC_M5982	UCS	K.2.1
Li	Danny		DC_PHO0057		K.3.1
Li	Lewyn		DC_M4724	UCS	K.2.1
Liberasi	Hari		DC_M6067	UCS	K.2.1
Liberasi	Hari		DC_M7261	UCS	K.2.1
Libois	Roland		DC_M4773	UCS	K.2.1
Licht	Suzanne		DC_M0062		K.2.1
Lichty	Donald		DC_M7698		K.3.2, K.3.3, K.3.7, K.3.11, K.3.13, K.3.15
Liddil	Bruce		DC_M6331	UCS	K.2.1
Lieb	Louise		DC_M6595	UCS	K.2.1
Lieber	Susan		DC_M4097	UCS	K.2.1
Lieberman	Yehudit		DC_M4252	UCS	K.2.1
Lien	Matthew		DC_M1376	UCS	K.2.1
Lienau	Michael		DC_M3478	UCS	K.2.1
Lieu	Warren		DC_M1438	UCS	K.2.1
Lihs	Ria		DC_M6766	UCS	K.2.1
Lilianthal	Patricia		DC_M2696	UCS	K.2.1
Lilleberg	Allen		DC_M3427	UCS	K.2.1
Lillien	Irving		DC_M7902		K.2.3
Lima	Ann		DC_M3021	UCS	K.2.1
Limbach	Jalaine		DC_M2467	UCS	K.2.1
Lin	Joyce		DC_M7075	UCS	K.2.1
Lin	Lawrence		DC_M0641		K.2.1
Linck	Mary		DC_M2442	UCS	K.2.1
Lincoln	Amelia		DC_M3490	UCS	K.2.1
Lind	Karen		DC_M0104		K.2.1
Linderman	Shawn		DC_M4818	UCS	K.2.1
Linderman	Shawn		DC_M4819	UCS	K.2.1
Lindley	L. Clark		DC_M2894	UCS	K.2.1
Lindor	Carl		DC_M7663	UCS	K.2.1
Lindsay	Elizabeth		DC_M6853	UCS	K.2.1
Lindsay	Jeanne		DC_M4809	UCS	K.2.1
Lindsey	Barbara		DC_M3765	UCS	K.2.1
Lindstrom-Dake	Erica		DC_M6705	UCS	K.2.1
Lingburg	Jim		DC_PHO0017	Friends Committee on Legislation in California	K.3.1, K.3.2, K.3.3, K.3.12, K.3.13
Lininger	Christine		DC_M5396	UCS	K.2.1
Link	Debra		DC_M1111	UCS	K.2.1
Link	Ellen		DC_M4838	UCS	K.2.1
Link	Ursala		DC_M7579	UCS	K.2.1
Linkhorst	Mark		DC_M6365	UCS	K.2.1
Linser	Eliza		DC_M3062	UCS	K.2.1
Liolis	Donna		DC_M1573	UCS	K.2.1
Liolis	Donna		DC_M1574	UCS	K.2.1
Lipari	Philip		DC_M2940	UCS	K.2.1

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Lippert	80918		DC_M2527	UCS	K.2.1
Lippert	Timothy		DC_M2967	UCS	K.2.1
Lipponen	Marjo		DC_M6475	UCS	K.2.1
Lipton	Robert		DC_M0466		K.2.1
Listig	Mario		DC_M4931	UCS	K.2.1
Liston	David		DC_M1406	UCS	K.2.1
Lite	Joseph		DC_M4111	UCS	K.2.1
Litfin	Dennis		DC_M2471	UCS	K.2.1
Litt	Judith		DC_M7309	UCS	K.2.1
Little	Dawn		DC_M7042	UCS	K.2.1
Little	James G.		DC_M0513		K.2.1
Little	Terri L		DC_M2450	UCS	K.2.1
Littleton	Kelly		DC_M2619	UCS	K.2.1
Littleton	Walter		DC_M3166	UCS	K.2.1
Litvin	Timothy		DC_M3118	UCS	K.2.1
Litzau	Jack		DC_M0974	UCS	K.2.1
Liu	Ted		DC_M2799	UCS	K.2.1
Livermore	Lewis		DC_M1710	UCS	K.2.1
Livermore	Mike		DC_M7846		K.2.1
Livesay	George		DC_M7823		K.2.3
Livingston	Amy		DC_M6151	UCS	K.2.1
Livingston	James		DC_M2440	UCS	K.2.1
Livingston	Patsy		DC_M0588		K.2.1
Lloyd	Georgia		DC_M4124	UCS	K.2.1
Lloyd	Nancy		DC_M5085	UCS	K.2.1
Loar	Carol		DC_M3006	UCS	K.2.1
Lobel	Colleen		DC_M0724		K.2.1
LoBuglio	Mary		DC_M0264		K.3.14
Locascio	Julie		DC_M4192	UCS	K.2.1
Lochner	Jan		DC_M5739	UCS	K.2.1
Locke	Hollis Hal		DC_M4378	UCS	K.2.1
Locke	Karen		DC_M6895	UCS	K.2.1
Lococo	Lois		DC_M3424	UCS	K.2.1
Loder	Doris		DC_M0294		K.3.2, K.3.3, K.3.4, K.3.6, K.3.7, K.3.13, K.3.15
Loeff	Peter		DC_M2078	UCS	K.2.1
Loerzel	Nicole		DC_M1068	UCS	K.2.1
Lofgren	Mary Joan		DC_E0333		K.3.12
Logan	Chris		DC_M1375	UCS	K.2.1
Logan	Heather		DC_M4587	UCS	K.2.1
Lohr	Diane		DC_M0114		K.2.1
Lok	Munchi		DC_M1538	UCS	K.2.1
Lollar	Lonetta		DC_M5011	UCS	K.2.1
Lombard	Carole		DC_E0269	Sisters of St. Joseph	K.3.1, K.3.2
Lombardi	Stephanie		DC_M3082	UCS	K.2.1
Londowski	Jan		DC_M1261	UCS	K.2.1
Lonergan	Lorena		DC_M5832	UCS	K.2.1
Long	Bonnie		DC_M5820	UCS	K.2.1
Long	Cindy		DC_E0138		K.3.18
Long	Diane		DC_M7237	UCS	K.2.1
Long	Jeanne		DC_M5973	UCS	K.2.1
Long	Kathy		DC_M2690	UCS	K.2.1
Long	Kit		DC_M6586	UCS	K.2.1
Long	Marilyn Jane		DC_M5609	UCS	K.2.1
Long	Mary		DC_M2730	UCS	K.2.1
Longino	Tera		DC_M0243		K.3.14
Longson	Arlene		DC_M5851	UCS	K.2.1
Longson	Arlene		DC_M5852	UCS	K.2.1

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Longwell	Medini		DC_E0033		K.3.2, K.3.7, K.3.12, K.3.13, K.3.15
Look	Joanne		DC_M6242	UCS	K.2.1
Loomis	Charles		DC_M2986	UCS	K.2.1
Looney	Stephanie		DC_M6320	UCS	K.2.1
Loosier	Carla Sue		DC_M3505	UCS	K.2.1
Lopez	Eliud		DC_M0602		K.2.1
Lopez	Jose		DC_M2586	UCS	K.2.1
Lopez	Richard		DC_M2277	UCS	K.2.1
Lopez-Strother	Christina		DC_M1612	UCS	K.2.1
Lorang	Joe		DC_M1740	UCS	K.2.1
Lord	Charles	Joy Lord	DC_E0038		K.3.2, K.3.4, K.3.11, K.3.12, K.3.13
Lorent	Kristin		DC_M3846	UCS	K.2.1
Lorgeoux	Anne		DC_M2179	UCS	K.2.1
Loria	Steven		DC_M3775	UCS	K.2.1
Lorts	Tony R.		DC_M4817	UCS	K.2.1
Lorusso	Nichole		DC_M5134	UCS	K.2.1
Loscalzo-Stumpf	Merry		DC_M5935	UCS	K.2.1
Lotz	Jonathan		DC_M4230	UCS	K.2.1
Loughlin	Carol		DC_M2377	UCS	K.2.1
Loughlin	Michaelene		DC_M0191		K.2.1
Louis	Dorothy		DC_M1900	UCS	K.2.1
Louisa			DC_M6350	UCS	K.2.1
Loungreck	Lillia		DC_M0009		K.2.2
Lounsbury	Mary		DC_M6222	UCS	K.2.1
Louthen-Brown	Willie		DC_M2557	UCS	K.2.1
Love	Michael G.		DC_M3974	UCS	K.2.1
Loveall-Rowe	Kristie		DC_M4062	UCS	K.2.1
Loveland	Jim		DC_E0154		K.3.1
Lovett	Dodie		DC_M1039	UCS	K.2.1
Lovett	Marguerite D.		DC_M1196	UCS	K.2.1
Lovett	Marguerite D.		DC_M6453	UCS	K.2.1
Lowe	Brian		DC_M6695	UCS	K.2.1
Lowell	Jacquie		DC_M5377	UCS	K.2.1
Lowry	Kathleen		DC_M1863	UCS	K.2.1
Lowther	Chad		DC_M2462	UCS	K.2.1
Loyd	Aaron		DC_M6933	UCS	K.2.1
Lu	Carole		DC_M0044		K.2.1
Lu	Sharon		DC_M5214	UCS	K.2.1
Luanglue	Melisa		DC_M7328	UCS	K.2.1
Lubbers	Susan E.		DC_M1865	UCS	K.2.1
Lubensky	Earl		DC_M5435	UCS	K.2.1
Lubic	Steve J.		DC_M7744		K.2.1
Lubin	Carolyn		DC_M2492	UCS	K.2.1
Lubinsky	Jennifer		DC_M5952	UCS	K.2.1
Lubofsky	Melissa		DC_M6935	UCS	K.2.1
Lubonovich	D. Jean		DC_M2698	UCS	K.2.1
Lubow	Craig		DC_M0730		K.2.1
Lucas	Adeline		DC_M4597	UCS	K.2.1
Lucas	Amanda		DC_M5750	UCS	K.2.1
Lucas	Amanda		DC_M5750	UCS	K.2.1
Lucas	Lucas		DC_M5007	UCS	K.2.1
Lucey	Marie		DC_M5369	UCS	K.2.1
Lucey	Susan		DC_M3117	UCS	K.2.1
Luck	Curt		DC_M7621	UCS	K.2.1
Luckman	Marleen		DC_M1642	UCS	K.2.1
Ludwig	Frank		DC_M5812	UCS	K.2.1
Ludwig-Levine	Judith		DC_M2632	UCS	K.2.1

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Luehrmann	Paul		DC_M5406	UCS	K.2.1
Lueth	David		DC_M0105		K.2.1
Luetkemeyer	Benita		DC_E0284		K.3.3, K.3.4, K.3.5, K.3.11
Lugo	Cristobal		DC_M0908	UCS	K.2.1
Lukachinsky	Mark		DC_M3122	UCS	K.2.1
Lukatch	Miranda		DC_M4482	UCS	K.2.1
Lum	Allen		DC_M0183	member: CARD, UCS	K.3.1, K.3.13, K.3.14
Lumsden	Caron		DC_M3862	UCS	K.2.1
Lund	Elizabeth		DC_M6652	UCS	K.2.1
Lundeen	Eric		DC_M1674	UCS	K.2.1
Lundeen	James		DC_M1271	UCS	K.2.1
Lundell	Peter		DC_M1137	UCS	K.2.1
Lundy	Ava		DC_M3442	UCS	K.2.1
Lundy	Joellen		DC_M2396	UCS	K.2.1
Luppo	Albert		DC_M6002	UCS	K.2.1
Luria	Mayra		DC_M6733	UCS	K.2.1
Lusch	Mark		DC_M4737	UCS	K.2.1
Luxem	David		DC_M2624	UCS	K.2.1
Lyle	John		DC_M0063		K.3.1, K.3.2, K.3.3, K.3.4, K.3.10
Lyles	Jeff		DC_M1815	UCS	K.2.1
Lynch	Michal		DC_M6216	UCS	K.2.1
Lynch	Nancy		DC_M0045		K.3.2, K.3.3, K.3.7, K.3.10, K.3.12, K.3.13, K.3.15
Lynch	Nancy		DC_M0262		K.3.2, K.3.3, K.3.12, K.3.13, K.3.15, K.4
Lynd	Celia N.		DC_M3550	UCS	K.2.1
Lyndly	Jenna		DC_M5567	UCS	K.2.1
Lyndsong	Gwen		DC_M5729	UCS	K.2.1
Lyon	Dawn		DC_M4451	UCS	K.2.1
Lyon	Dawn		DC_M6903	UCS	K.2.1
Lyons	Anthony		DC_M5387	UCS	K.2.1
Lyons	Leah		DC_M2059	UCS	K.2.1
Lyons	Nicole-Marie		DC_M1388	UCS	K.2.1
Lyons	Patricia		DC_M4539	UCS	K.2.1
Mabry	Hunter		DC_M2242	UCS	K.2.1
MacAdam-Miller	Jennifer		DC_M2084	UCS	K.2.1
MacAlpine	Deirdre		DC_M7054	UCS	K.2.1
Macaluso	Marie		DC_M5055	UCS	K.2.1
MacArthur	June		DC_M4656	UCS	K.2.1
Macaulay	Katharine		DC_M2501	UCS	K.2.1
MacCallum	Crawford		DC_M4503	UCS	K.2.1
MacCaughey	Caroline		DC_M7413	UCS	K.2.1
Macchia	Tom		DC_PHO0041		K.3.1, K.3.2, K.3.7, K.3.10
MacDonald	Barbara		DC_M5464	UCS	K.2.1
MacDonald	Graeme		DC_M7088	UCS	K.2.1
MacDonald	Lynn		DC_M1300	UCS	K.2.1
MacDonald	Meilani		DC_M7179	UCS	K.2.1
MacDonald	Myra		DC_M6612	UCS	K.2.1
MacDonald	Paula		DC_M4295	UCS	K.2.1
Macdonald	Rod		DC_PHO0010		K.3.2, K.3.11, K.3.15, K.4
MacFadyen	John P		DC_M3729	UCS	K.2.1
Maciboba	Leila		DC_M7666	UCS	K.2.1
Mack	Ben		DC_M2846	UCS	K.2.1
Mack	Judy		DC_M7836		K.2.1
Mack	Rainbow		DC_M1586	UCS	K.2.1
MacKanic	Janice		DC_M2171	UCS	K.2.1
Mackay	William P.		DC_M4197	UCS	K.2.1

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Mackenzie	Douglass		DC_M3749	UCS	K.2.1
MacKenzie	Kendra		DC_M1970	UCS	K.2.1
Mackenzie	Kenneth		DC_M1163	UCS	K.2.1
Mackenzie	Susan		DC_M3576	UCS	K.2.1
Mackey	Frederick		DC_M4553	UCS	K.2.1
MacLaughlin	Jan		DC_M2875	UCS	K.2.1
Macmillan	Elizabeth		DC_M6314	UCS	K.2.1
MacMillan	Jan		DC_M7682	UCS	K.2.1
MacNichol	Susan		DC_M5471	UCS	K.2.1
Macphail	Jean		DC_M7032	UCS	K.2.1
MacRae	D		DC_M5785	UCS	K.2.1
Macvicar	Mary		DC_M3989	UCS	K.2.1
Macy	Dan		DC_M6055	UCS	K.2.1
Madarasz	Michael		DC_M4701	UCS	K.2.1
Madden	Mary		DC_M4087	UCS	K.2.1
Maddox	Melvyn		DC_M0982	UCS	K.2.1
Madison	Mary		DC_M0523		K.2.1
Madsen	Libbe		DC_M4739	UCS	K.2.1
Magee	George		DC_M2193	UCS	K.2.1
Magee	P		DC_M3356	UCS	K.2.1
Magee	Richard		DC_M0350		K.2.1
Magers	Sally		DC_M5928	UCS	K.2.1
Magnavita	Helen		DC_M7078	UCS	K.2.1
Magnusson	Freddy		DC_E0310		K.3.2, K.3.3, K.3.12, K.3.13, K.3.15
Magzis	Laura		DC_M1136	UCS	K.2.1
Mahajan	Romi		DC_M1775	UCS	K.2.1
Mahan	Mary Jane		DC_M0311		K.2.1
Mahan	Trevor		DC_M7423	UCS	K.2.1
Mahiques	Diane		DC_M1638	UCS	K.2.1
Mahoney	Linda		DC_M6258	UCS	K.2.1
Mahoney	Matt		DC_M0681		K.2.1
Mahrt	Jack		DC_M6261	UCS	K.2.1
Maier	Margaret		DC_M0002		K.2.2
Maifeld	Greg		DC_M3226	UCS	K.2.1
Main	Isabel		DC_M2112	UCS	K.2.1
Majkowicz	Lester		DC_M1609	UCS	K.2.1
Mak	Vivian		DC_M1369	UCS	K.2.1
Maker	Janet		DC_M7024	UCS	K.2.1
Makowski	James		DC_M5446	UCS	K.2.1
Makruski	Adam		DC_M4303	UCS	K.2.1
Mal	Mal		DC_M1160	UCS	K.2.1
Malcolm	Pat		DC_M7382	UCS	K.2.1
Malek	Ariel		DC_M0237		K.2.1
Malkus	Karen		DC_M4885	UCS	K.2.1
Mallard	Ann		DC_M1309	UCS	K.2.1
Malloy	Ben		DC_M6494	UCS	K.2.1
Malmuth	Sonja		DC_M7043	UCS	K.2.1
Malone	Joan		DC_M0115		K.3.2, K.3.6, K.3.7, K.3.15
Malone	Sheila		DC_M5061	UCS	K.2.1
Maloney	Ken		DC_M0978	UCS	K.2.1
Maloney	Ken		DC_M0981	UCS	K.2.1
Maloney	Paul		DC_M1424	UCS	K.2.1
Malouf	Fred		DC_M7058	UCS	K.2.1
Malter	Rosalie		DC_M2022	UCS	K.2.1
Manalo	Michael		DC_M1523	UCS	K.2.1
Mancini	Janice		DC_M6561	UCS	K.2.1
Mandel	Dorothy		DC_M3054	UCS	K.2.1
Manganiello	Paul		DC_M5437	UCS	K.2.1

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Mangapit	Marion		DC_M1646	UCS	K.2.1
Mangino	Pat		DC_M1224	UCS	K.2.1
Mangione	Raymond		DC_M4407	UCS	K.2.1
Mangum	Carl		DC_M6986	UCS	K.2.1
Manhan	Diana		DC_M2861	UCS	K.2.1
Manis	Lisa		DC_M6338	UCS	K.2.1
Mank	Jean		DC_M1108	UCS	K.2.1
Mann	Matthew		DC_M3894	UCS	K.2.1
Manning	(Family)		DC_M1961	UCS	K.2.1
Manning	Christel		DC_M2606	UCS	K.2.1
Manning	Dona		DC_M4901	UCS	K.2.1
Manning	Gary		DC_M3323	UCS	K.2.1
Manning	Mackenzie		DC_M3872	UCS	K.2.1
Manning	Paul		DC_M7614	UCS	K.2.1
Manoj	Paul		DC_M0474		K.2.1
Manon	Peter		DC_M2523	UCS	K.2.1
Manousos	Anthony		DC_E0264		K.2.3
Mansell	Christinia		DC_M1520	UCS	K.2.1
Manske	Jill		DC_M0608		K.2.1
Mantey	Christine		DC_M2315	UCS	K.2.1
Marantz	Kenneth		DC_M7462	UCS	K.2.1
Marceau	Rachel		DC_M2914	UCS	K.2.1
Marcel	Lorretta		DC_M6062	UCS	K.2.1
March	Lori		DC_M0676		K.2.1
March	Lori		DC_M4250	UCS	K.2.1
Marcia	Merithew		DC_M3892	UCS	K.2.1
Marcialis	Donna		DC_M2407	UCS	K.2.1
Marciniak	Cathy		DC_M5740	UCS	K.2.1
Marcontell	Brian		DC_M4942	UCS	K.2.1
Marcus	Marvin		DC_M1871	UCS	K.2.1
Marcus	MS		DC_M6173	UCS	K.2.1
Marcus	Naomi		DC_M0951	UCS	K.2.1
Mares	Robert		DC_M4082	UCS	K.2.1
Maresca	Josh		DC_M0698		K.2.1
Margaret	Maier		DC_E0059		K.2.2
Marhefka	Gladys		DC_M0238	Social Justice Coordinator, The Grey Nuns	K.2.2
Maria	T.		DC_M3655	UCS	K.2.1
Maricque	Mitchell		DC_M6263	UCS	K.2.1
Marie	Sylvia		DC_M7225	UCS	K.2.1
Marilyn	Wilson		DC_E0225	Women's Office Sisters of Charity	K.2.2
Marion	Jeanne		DC_M2178	UCS	K.2.1
Marjoricastle	Val		DC_M0806	UCS	K.2.1
Markham	Thomas		DC_M3825	UCS	K.2.1
Markley	Shannon		DC_M4058	UCS	K.2.1
Markman	Cheryl		DC_M5482	UCS	K.2.1
Markowitz	Stephen		DC_M6738	UCS	K.2.1
Marks	MK	Peter Marks	DC_M5450	UCS	K.2.1
Marks	N. Lee		DC_M1378	UCS	K.2.1
Markum	Constance		DC_M3380	UCS	K.2.1
Markus	Mary		DC_M1814	UCS	K.2.1
Markus	Mary		DC_M6438	UCS	K.2.1
Marlier	Emilie		DC_M1973	UCS	K.2.1
Marlow	Eric		DC_M5327	UCS	K.2.1
Marnusson-Schmidt	Diane		DC_M7270	UCS	K.2.1
Maron	Country		DC_M4354	UCS	K.2.1

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Maron	Country		DC_M5414	UCS	K.2.1
Maron	Country		DC_M5415	UCS	K.2.1
Marquardt	Paul		DC_M2246	UCS	K.2.1
Marquis-Homeyer	Catherine		DC_E0331	Peace Economy Project	K.3.1, K.3.2, K.3.3, K.3.4, K.3.7, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15
Marquis-Homeyer	Catherine		DC_E0400		K.3.1, K.3.2, K.3.3, K.3.4, K.3.7, K.3.10, K.3.11, K.3.12,K.3.13, K.3.15
Marquis-Homeyer	Catherine		DC_M0339		K.2.1
Marr	Melina		DC_M0867	UCS	K.2.1
Marriott	David		DC_M7397	UCS	K.2.1
Mars	Paul		DC_E0058		K.3.4, K.3.7
Marsh	Betty		DC_M5279	UCS	K.2.1
Marsh	Betty		DC_M7512	UCS	K.2.1
Marsh	Melba		DC_M5745	UCS	K.2.1
Marsh	Timothy		DC_M1634	UCS	K.2.1
Marshall	Bryan		DC_M0859	UCS	K.2.1
Marshall	David		DC_M1221	UCS	K.2.1
Marshall	Elizabeth		DC_M7720		K.2.3
Marshall	Garry		DC_M3379	UCS	K.2.1
Marshall	Jeanne		DC_M3132	UCS	K.2.1
Marshall	Laurence D. M.		DC_M4166	UCS	K.2.1
Marshall	Lisa		DC_M6248	UCS	K.2.1
Marshall	Margaret		DC_M7400	UCS	K.2.1
Marsot	Alain		DC_M4855	UCS	K.2.1
Marston	Natasha		DC_M5241	UCS	K.2.1
Martell	Catherine		DC_M0219		K.3.2, K.3.10, K.3.14
Martell	Jonathan		DC_M2772	UCS	K.2.1
Martha	Waltman		DC_M4264	UCS	K.2.1
Martin	Alice F.		DC_M4346	UCS	K.2.1
Martin	Angela		DC_M1100	UCS	K.2.1
Martin	Bette		DC_M7352	UCS	K.2.1
Martin	Carol		DC_M3450	UCS	K.2.1
Martin	Chad		DC_M3705	UCS	K.2.1
Martin	Charles		DC_M2167	UCS	K.2.1
Martin	Christopher		DC_M0965	UCS	K.2.1
Martin	David		DC_E0150		K.3.14
Martin	David III		DC_M1731	UCS	K.2.1
Martin	Deb		DC_M5255	UCS	K.2.1
Martin	Diane		DC_M4723	UCS	K.2.1
Martin	Diane		DC_M5142	UCS	K.2.1
Martin	Elandriel		DC_M6138	UCS	K.2.1
Martin	Jayne		DC_M3146	UCS	K.2.1
Martin	Jill		DC_M0519		K.2.1
Martin	Joseph		DC_M1645	UCS	K.2.1
Martin	Kathleen		DC_M7728		K.2.1
Martin	Lisa Ann		DC_M3780	UCS	K.2.1
Martin	Maria		DC_M1762	UCS	K.2.1
Martin	Michele		DC_M6994	UCS	K.2.1
Martin	Nancy		DC_M3238	UCS	K.2.1
Martin	Suanne		DC_M4324	UCS	K.2.1
Martin	Thomas		DC_M3556	UCS	K.2.1
Martin	Tim		DC_M2431	UCS	K.2.1
Martineau	Claire		DC_M0159		K.3.10, K.3.14
Martinez	Candida		DC_M3050	UCS	K.2.1
Martinez	Carol		DC_M3104	UCS	K.2.1
Martinez	Nelly		DC_M1760	UCS	K.2.1
Martino	Nicole		DC_M2308	UCS	K.2.1

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Martino	Robert		DC_M3167	UCS	K.2.1
Martinsen	Paul		DC_M1322	UCS	K.2.1
Martorell	Elizabeth		DC_E0184		K.3.1, K.3.2, K.3.3, K.3.11, K.3.12
Marty	Elsa		DC_M3007	UCS	K.2.1
Martz	Russell		DC_M2963	UCS	K.2.1
Martz	Russell		DC_M6674	UCS	K.2.1
Marvin	James		DC_M5932	UCS	K.2.1
Masi	Melody		DC_M3806	UCS	K.2.1
Masic	Dunja		DC_M6957	UCS	K.2.1
Maslanek	Micheal		DC_M2514	UCS	K.2.1
Maslyar	George		DC_M2251	UCS	K.2.1
Mason	Anita		DC_E0373		K.3.1, K.3.2, K.3.3, K.3.4, K.3.11, K.3.12, K.3.15, K.4
Mason	Dave		DC_M4993	UCS	K.2.1
Mason	Donita		DC_M3033	UCS	K.2.1
Mason	Henry		DC_M5022	UCS	K.2.1
Mason	Patricia		DC_M0008		K.3.1, K.3.2, K.3.6, K.3.7, K.3.10, K.3.12, K.3.13, K.3.15
Mason	Virginia		DC_M2537	UCS	K.2.1
Massafra	Samuel		DC_M6003	UCS	K.2.1
Massarella	Nance		DC_M1618	UCS	K.2.1
Massimini	Esther		DC_M2928	UCS	K.2.1
Masters	Dale Lee		DC_M1681	UCS	K.2.1
Mastrella	Elizabeth		DC_M0429		K.2.1
Mastrogiovanni	Jessica		DC_M4828	UCS	K.2.1
Masuret	Dorothea		DC_E0313		K.3.12
Mata	Muriel		DC_M4114	UCS	K.2.1
Mateer	Bob	Bernie Mateer	DC_M4059	UCS	K.2.1
Matellaro	Karen		DC_M0757		K.2.1
Materna	Gayle		DC_M7594	UCS	K.2.1
Mathaler	Sabrina		DC_M5950	UCS	K.2.1
Mathes	Fred		DC_M5322	UCS	K.2.1
Mathews	Richard		DC_M0749		K.2.1
Mathews	Tamara		DC_M3014	UCS	K.2.1
Mathews	Thomas		DC_M5410	UCS	K.2.1
Mathrani	Vandana		DC_M7762		K.2.1
Matlock	KL		DC_M4044	UCS	K.2.1
Matthews	David		DC_M3426	UCS	K.2.1
Matthews	Kelly		DC_M1679	UCS	K.2.1
Mattingly	Victoria		DC_M7908		K.2.1
Mattison	Scott		DC_M2952	UCS	K.2.1
Matton	Joyce		DC_M1952	UCS	K.2.1
Mattson	Karen		DC_M2487	UCS	K.2.1
Matz	Tamara		DC_M6004	UCS	K.2.1
Mau	Gregg		DC_M4715	UCS	K.2.1
Mauk	Caryl		DC_M4789	UCS	K.2.1
Mauritz	Kristal		DC_M6034	UCS	K.2.1
Maus	Jim		DC_M0969	UCS	K.2.1
Mausteller	Tapherine		DC_M1590	UCS	K.2.1
Maxfield	Richard		DC_M7630	UCS	K.2.1
Maxfield	Tania Gonzales		DC_M7048	UCS	K.2.1
May	Julie		DC_M2743	UCS	K.2.1
May	Linda D.		DC_M5102	UCS	K.2.1
Maybury	John		DC_M6093	UCS	K.2.1
Mayer	Deb		DC_M0367		K.2.1
Mayer	Vic		DC_M7688		K.2.1
Mayers	Mindy		DC_M7461	UCS	K.2.1
Mayhew	Paul		DC_M0078		K.2.1

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Maynard	Aurelia		DC_M5988	UCS	K.2.1
Maynard	Barbara		DC_M0604		K.2.1
Maynard	Heather		DC_M4512	UCS	K.2.1
Mazur	Ruth		DC_E0122		K.3.9
McAdam	Kyle		DC_M6942	UCS	K.2.1
McAdoo	Gail		DC_M2802	UCS	K.2.1
McAdoo	Nancy		DC_M6131	UCS	K.2.1
McAfee	Beth		DC_M0211		K.2.1
McAfee	Beth		DC_M6485	UCS	K.2.1
McAlear	Ehummer		DC_M6229	UCS	K.2.1
Mcaneny	Priscilla		DC_M6623	UCS	K.2.1
McAninch	Edwyna		DC_M5882	UCS	K.2.1
McAnnally	Karen		DC_M2081	UCS	K.2.1
McAnnally	Karen		DC_M2082	UCS	K.2.1
McBride	Alicia		DC_E0108		K.3.3, K.3.4, K.3.7, K.3.10, K.3.13, K.3.15
McCabe	James		DC_M1350	UCS	K.2.1
McCable	Charlotte		DC_M2512	UCS	K.2.1
McCahill	Jay		DC_M6879	UCS	K.2.1
McCann	Cathleen		DC_M6362	UCS	K.2.1
McCann	Kathy		DC_M5779	UCS	K.2.1
McCardell	Jean		DC_M6381	UCS	K.2.1
McCarthy	Barbara		DC_M2076	UCS	K.2.1
McCarthy	Camille		DC_M4427	UCS	K.2.1
McCarthy	Deborah		DC_M6775	UCS	K.2.1
McCarthy	Joellen	Peggy Nolan and Mary Ann Zollmann	DC_M0239	Sisters of Charity of the Blessed Virgin Mary	K.2.2
McCarty	Michael		DC_M5666	UCS	K.2.1
McCarty	Patricia		DC_M1414	UCS	K.2.1
McCarty	Tom		DC_M2111	UCS	K.2.1
McChesney	Evelyn		DC_M5517	UCS	K.2.1
McClain	Anne		DC_M3504	UCS	K.2.1
McClatchey	Walter P.		DC_M1049	UCS	K.2.1
McCleary	Harriet		DC_M5672	UCS	K.2.1
McClure	Joanna		DC_M5056	UCS	K.2.1
McClure	Sandy		DC_M2773	UCS	K.2.1
McCollom	Scott		DC_M5024	UCS	K.2.1
McCombs	Avery		DC_M3624	UCS	K.2.1
McConnell	Amanda		DC_M1673	UCS	K.2.1
McConochie	Micah		DC_M0464		K.2.1
McCool	Joseph		DC_M2170	UCS	K.2.1
McCormack	Kevin		DC_M0580		K.2.1
McCormack	Mary Ann		DC_M2535	UCS	K.2.1
McCormack	Rita		DC_E0303		K.3.12
McCormick	Jennifer		DC_M4608	UCS	K.2.1
McCormick	Theresa		DC_M5323	UCS	K.2.1
McCoy	Kim		DC_M5606	UCS	K.2.1
McCoy	Sandra		DC_M0891	UCS	K.2.1
McCradic	Kris		DC_M5111	UCS	K.2.1
McCrea	Melanie		DC_M0659		K.2.1
McCredie	Brian		DC_M5021	UCS	K.2.1
McCuistion	Kathleen		DC_M1729	UCS	K.2.1
McCuistion	Kathleen		DC_M6123	UCS	K.2.1
McCullough	Al		DC_M7780		K.3.1, K.3.2, K.3.3, K.3.4, K.3.5, K.3.10, K.3.11, K.3.13, K.3.15
McCullough	Charles W.		DC_M1327	UCS	K.2.1
McCullough	Megan		DC_M6143	UCS	K.2.1

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McCullough	Paula		DC_M4477	UCS	K.2.1
McDaniel	Jennifer		DC_M7856		K.2.1
McDaniel	Marsha		DC_M6225	UCS	K.2.1
McDaniel	Marsha		DC_M6226	UCS	K.2.1
McDermond	Timothy		DC_M3313	UCS	K.2.1
McDermott	Mark		DC_M7898		K.3.3, K.3.7, K.3.10, K.3.13, K.3.14
McDermott	Rosalind		DC_M6667	UCS	K.2.1
McDermott-Burns	Kelley		DC_M6771	UCS	K.2.1
McDonald	Daniel		DC_E0187		K.2.4
McDonald	Judy		DC_M4229	UCS	K.2.1
McDonald	Kathy		DC_M4895	UCS	K.2.1
McDonald	Lori		DC_M0819	UCS	K.2.1
McDonald	Shari		DC_M0895	UCS	K.2.1
McDonald	William		DC_M3745	UCS	K.2.1
McDowell	Christine		DC_M3271	UCS	K.2.1
McEachern	Cathy		DC_M4700	UCS	K.2.1
McEachron Taylor	Linda Lee		DC_M6098	UCS	K.2.1
McEathron	Rosemary		DC_M0106		K.2.1
McElhill	Betty		DC_E0137		K.3.10, K.3.12, K.3.14
McElroy	Lucy		DC_M5518	UCS	K.2.1
McEntee	Janet		DC_M3406	UCS	K.2.1
McFadyen	Victoria		DC_M7401	UCS	K.2.1
McFarland	Mary Ann		DC_M7374	UCS	K.2.1
McGary	Robin		DC_M4261	UCS	K.2.1
McGaughy	Robert E.		DC_M1474	UCS	K.2.1
McGee	Bob		DC_E0379		K.3.10, K.3.14
McGee	John		DC_M3535	UCS	K.2.1
McGee Jr	Brian		DC_M2409	UCS	K.2.1
McGettigan	Kellie		DC_M6719	UCS	K.2.1
McGinnis	Kathleen M.		DC_M7250	UCS	K.2.1
McGinty	Alison		DC_M7303	UCS	K.2.1
McGivern	Mary Ann		DC_E0214		K.2.2 and K.3.10
McGlone	Colleen		DC_M0410		K.2.1
McGlone	Gail		DC_M6490	UCS	K.2.1
McGonagle	Rachel		DC_M4241	UCS	K.2.1
McGrath	Mark	Mary McGrath	DC_M1086	UCS	K.2.1
Mcgrath	Moira		DC_M6117	UCS	K.2.1
McGregor	RobRoy		DC_M5496	UCS	K.2.1
McGregor	Teresa		DC_M6907	UCS	K.2.1
McGuire	Megan		DC_M3949	UCS	K.2.1
McIlwaine	Andy		DC_M2659	UCS	K.2.1
McIntyre	Heather		DC_M0856	UCS	K.2.1
McIntyre	Susan		DC_M6563	UCS	K.2.1
McKay	Chris		DC_M6061	UCS	K.2.1
McKee	Brian		DC_M0804	UCS	K.2.1
McKeel	Diane		DC_M0443		K.2.1
McKeever	Timothy		DC_M3986	UCS	K.2.1
McKeirnan	Leigh		DC_M6786	UCS	K.2.1
McKelvey	Don		DC_M0533		K.2.1
McKelvey	Don		DC_M1399	UCS	K.2.1
McKenna	Shayla		DC_M7493	UCS	K.2.1
McKenzie	Catherine		DC_M5968	UCS	K.2.1
McKenzie	Laura		DC_M0331		K.2.1
McKeon	Sheila		DC_M1614	UCS	K.2.1
McKeon	Susan		DC_M5927	UCS	K.2.1
McKinley	Mark		DC_M5334	UCS	K.2.1
McKinney	Marilyn		DC_M4616	UCS	K.2.1
McKinney	Sam		DC_M4678	UCS	K.2.1

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McKinstry	Dennis and Carol		DC_M2367	UCS	K.2.1
McKown	Julie		DC_M2588	UCS	K.2.1
McLane	John		DC_M0444		K.2.1
McLaughlin	Amanda		DC_M2706	UCS	K.2.1
Mclaughlin	Rachelle		DC_M1984	UCS	K.2.1
McLaurin	Megan		DC_M7503	UCS	K.2.1
McLean	Christina		DC_M0163		K.2.1
McLellan	Tracy		DC_E0004		K.2.2
McLeod	Damien		DC_M4541	UCS	K.2.1
McLoryd	Merry		DC_M1725	UCS	K.2.1
McMahan	Janet		DC_M3215	UCS	K.2.1
McMahon	Kenneth		DC_M4323	UCS	K.2.1
McMahon	Paul		DC_M7272	UCS	K.2.1
McManus	Micheal		DC_M3016	UCS	K.2.1
McMillan	Erik		DC_M1188	UCS	K.2.1
McMillen	Joseph		DC_M1151	UCS	K.2.1
McMillen	Joseph		DC_M1153	UCS	K.2.1
McMullan	A. Dale		DC_M7612	UCS	K.2.1
McMullin	William		DC_M2230	UCS	K.2.1
McMurray	Shane		DC_E0164		K.3.1, K.3.11
McMurtry	James M.		DC_M2038	UCS	K.2.1
McNamara	Timothy		DC_M2511	UCS	K.2.1
McNamara	Vivian		DC_M3713	UCS	K.2.1
McNeil	Alesa		DC_M7012	UCS	K.2.1
McNeil	JG		DC_M1977	UCS	K.2.1
McNichol	Lynn		DC_M0347		K.2.1
McNichol	Tim		DC_M0906	UCS	K.2.1
McNichols	Keith		DC_M7793		K.2.1
McNie	Helen		DC_M5436	UCS	K.2.1
McPeek	John		DC_M4929	UCS	K.2.1
McPhee	Nicole		DC_M3499	UCS	K.2.1
McPherson	Nevada		DC_M0454		K.2.1
McPherson	Suzanne		DC_M6964	UCS	K.2.1
McRae	Brandon		DC_M1017	UCS	K.2.1
McSwain	Robert		DC_M7686		K.2.1
McVarish	Linda		DC_M6785	UCS	K.2.1
McVoy	E.		DC_M6097	UCS	K.2.1
McWherter	Fran		DC_M6754	UCS	K.2.1
McWilliams	Cynthia		DC_M3627	UCS	K.2.1
Meacham	Julie		DC_M1386	UCS	K.2.1
Meacham	Michelle		DC_M0704		K.2.1
Mead	Benjamin		DC_M7033	UCS	K.2.1
Mead	Howard		DC_M7840		K.3.7, K.3.10, K.3.11, K.3.13, K.3.15
Mead	John		DC_M2995	UCS	K.2.1
Mead	Kathleen		DC_M3956	UCS	K.2.1
Mead	Kathleen		DC_M6074	UCS	K.2.1
Mead	Kathryn		DC_M5712	UCS	K.2.1
Mead	Marjorie		DC_M1857	UCS	K.2.1
Mead	Sam		DC_M2549	UCS	K.2.1
Meadows	Lynn		DC_E0175		K.2.2
Meagher	Ilona		DC_M7318	UCS	K.2.1
Meagher	Kathleen		DC_M5644	UCS	K.2.1
Media	Teresa		DC_M2948	UCS	K.2.1
Medious	Simone		DC_M2587	UCS	K.2.1
Medzihradsky	Oliver		DC_M7696		K.2.1
Mee	Diane		DC_M0093		K.2.1
Meehan	Nancy		DC_M0472		K.2.1

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Meek	Ted		DC_M6473	UCS	K.2.1
Meeks	B. Spencer		DC_M2660	UCS	K.2.1
Mehling-Wilson	Maryann		DC_M6727	UCS	K.2.1
Mehring	Walter		DC_M2939	UCS	K.2.1
Meierotto	Richard	Joan Meirerotto	DC_M0167		K.3.2, K.3.3, K.3.6, K.3.7, K.3.10, K.3.11
Meisner	Lorrain F		DC_M0968	UCS	K.2.1
Melby	Deborah		DC_M6536	UCS	K.2.1
Mellett	Ken		DC_M3987	UCS	K.2.1
Mellica	Jason		DC_M2312	UCS	K.2.1
Melling	Laura		DC_M5177	UCS	K.2.1
Melom	Jean		DC_M6335	UCS	K.2.1
Melone	Lisa		DC_M4774	UCS	K.2.1
Meloney	John		DC_M3732	UCS	K.2.1
Melsa	Linda		DC_M0897	UCS	K.2.1
Melvin	Robert L.		DC_M3957	UCS	K.2.1
Menard	David		DC_M6649	UCS	K.2.1
Menard	Jana		DC_M2876	UCS	K.2.1
Mendelsohn	Ellen		DC_M3805	UCS	K.2.1
Mendias	Jennifer		DC_M0470		K.2.1
Mendoza	E.		DC_M7457	UCS	K.2.1
Mennel-Bell	Mari		DC_M2923	UCS	K.2.1
Menyuk	Paula		DC_M2649	UCS	K.2.1
Mercer	Carol		DC_M6195	UCS	K.2.1
Mercer	E.		DC_M5030	UCS	K.2.1
Merchant	Sally		DC_M0892	UCS	K.2.1
Meredith	John		DC_M7189	UCS	K.2.1
Meresca	Josh		DC_M6121	UCS	K.2.1
Meridian	A.B.		DC_M3099	UCS	K.2.1
Merkh	Rebecca		DC_M0326		K.2.1
Merkin	Aaron		DC_M1463	UCS	K.2.1
Merrick	Kate		DC_M1668	UCS	K.2.1
Merrill	Ruth		DC_M3756	UCS	K.2.1
Merriman	Holly		DC_M6273	UCS	K.2.1
Merritt	Chanel		DC_M1866	UCS	K.2.1
Mertens	Stephanie		DC_M0010	Adorers of the Blood of Christ	K.2.2
Mertens	Stephanie		DC_M6555	UCS	K.2.1
Mertz	Robert		DC_M4347	UCS	K.2.1
Merz	Eugene		DC_E0183		K.2.2
Merz	Eugene		DC_E0195		K.2.2 and K.2.4
Messina	Annette		DC_M5806	UCS	K.2.1
Metcalf	A.		DC_M3954	UCS	K.2.1
Metcalf	Connie		DC_M0192		K.3.2, K.3.3, K.3.4, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15
Metheny	Nicholas		DC_M5150	UCS	K.2.1
Metsinger	PL		DC_M2297	UCS	K.2.1
Metsinger	PL		DC_M2298	UCS	K.2.1
Mettam	Diane		DC_M3303	UCS	K.2.1
Mettler	Bill		DC_M1584	UCS	K.2.1
Metzger	James	Judith Metzger	DC_M0203		K.3.4, K.3.6, K.3.7, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15
Meyer	Deanna		DC_M0919	UCS	K.2.1
Meyer	Mildred		DC_M7248	UCS	K.2.1
Meyer	Patricia		DC_M5065	UCS	K.2.1
Meyers	DeJay		DC_M7151	UCS	K.2.1
Meyers	Linda		DC_M2548	UCS	K.2.1
Meyers	M.S.		DC_M0418		K.2.1
Meyers	Marie		DC_M1983	UCS	K.2.1

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Meyerson	Howard		DC_M6734	UCS	K.2.1
Mich	Pam		DC_M6503	UCS	K.2.1
Michael	Ulrich		DC_M4302	UCS	K.2.1
Michaelides	Sarah		DC_M1135	UCS	K.2.1
Michal	Donald		DC_M6443	UCS	K.2.1
Michalak	Robert		DC_M1332	UCS	K.2.1
Micheals	Patricia		DC_M3044	UCS	K.2.1
Michel	Joseph		DC_M4184	UCS	K.2.1
Michelson	Kristen		DC_M6751	UCS	K.2.1
Middletown	Terri		DC_M0208		K.2.1
Midgett	Suz-Anne		DC_M6565	UCS	K.2.1
Mihalko	Kim		DC_M6554	UCS	K.2.1
Mihaly	Robert		DC_M4116	UCS	K.2.1
Mikalson	Claire		DC_M4215	UCS	K.2.1
Mikkelsen	David		DC_M5182	UCS	K.2.1
Mikkelson	Bette		DC_M0989	UCS	K.2.1
Milby	Lyle		DC_M4642	UCS	K.2.1
Milch	Mario		DC_M3115	UCS	K.2.1
Miles	Mara		DC_M4647	UCS	K.2.1
Miles	Ted		DC_M7146	UCS	K.2.1
Milianta	Merideth		DC_M5309	UCS	K.2.1
Militzer-Kopperl	Jennifer		DC_M3191	UCS	K.2.1
Millard	H.M.		DC_M0958	UCS	K.2.1
Millard	Jennifer		DC_M3694	UCS	K.2.1
Miller	Amy		DC_M2206	UCS	K.2.1
Miller	Anne Norton		DC_M0276	United States Environmental Protection Agency	K.5
Miller	Bret		DC_M7942		K.2.1
Miller	Brett		DC_M4783	UCS	K.2.1
Miller	Catherine		DC_M0090		K.2.1
Miller	Cheryl		DC_M7525	UCS	K.2.1
Miller	Clyde		DC_M1991	UCS	K.2.1
Miller	Clyde		DC_M1992	UCS	K.2.1
Miller	Dana		DC_M5922	UCS	K.2.1
Miller	Dianne		DC_M7053	UCS	K.2.1
Miller	Dona		DC_M2782	UCS	K.2.1
Miller	Doug		DC_M0427		K.2.1
Miller	Eric		DC_M5856	UCS	K.2.1
Miller	Francine		DC_M3305	UCS	K.2.1
Miller	Gabriel		DC_M3658	UCS	K.2.1
Miller	Gloria		DC_M7348	UCS	K.2.1
Miller	Griff		DC_M1849	UCS	K.2.1
Miller	Gutherie		DC_M7830		K.3.1
Miller	Jackie		DC_M3739	UCS	K.2.1
Miller	Joel		DC_M4316	UCS	K.2.1
Miller	Jon		DC_M3308	UCS	K.2.1
Miller	Juda		DC_M0244		K.2.1
Miller	Kathleen E.		DC_M6966	UCS	K.2.1
Miller	Kathryn		DC_M1014	UCS	K.2.1
Miller	Kathryn		DC_M1247	UCS	K.2.1
Miller	Kendrick W		DC_M2025	UCS	K.2.1
Miller	Margaret		DC_P0009		K.3.14
Miller	Mary		DC_M3361	UCS	K.2.1
Miller	Mary L.		DC_M7509	UCS	K.2.1
Miller	Matthew		DC_M6068	UCS	K.2.1
Miller	Nancy		DC_M4467	UCS	K.2.1
Miller	Neil		DC_M5029	UCS	K.2.1
Miller	Patricia		DC_M1299	UCS	K.2.1

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Miller	Paul		DC_M3106	UCS	K.2.1
Miller	Ralph		DC_M2874	UCS	K.2.1
Miller	Rebecca		DC_M1303	UCS	K.2.1
Miller	Stan		DC_E0081		K.2.2
Miller	Steven		DC_M4280	UCS	K.2.1
Miller	Susan		DC_M1704	UCS	K.2.1
Miller	Susan		DC_M1926	UCS	K.2.1
Miller	Thomas G.		DC_M1753	UCS	K.2.1
Miller-Tanner	Susan		DC_M3090	UCS	K.2.1
Milligan	Jennifer		DC_M7380	UCS	K.2.1
Milliman	John		DC_M1793	UCS	K.2.1
Milliman	John		DC_M6036	UCS	K.2.1
Mills	Coeta		DC_M7670	UCS	K.2.1
Mills	Cortney		DC_E0389		K.3.2, K.3.3, K.3.11, K.3.12, K.3.13, K.3.15
Mills	Kevin		DC_M0693		K.2.1
Mills	Marybeth		DC_E0034		K.3.6, K.3.7, K.3.11
Mills	Melva		DC_M1713	UCS	K.2.1
Mills	Rosemary		DC_M3192	UCS	K.2.1
Mills	Roy		DC_M4976	UCS	K.2.1
Milne	Bryan		DC_M4331	UCS	K.2.1
Milon	Joe		DC_M5096	UCS	K.2.1
Milstein	Karen		DC_M1036	UCS	K.2.1
Milton	J.W.	Mary Lee Milton	DC_M3312	UCS	K.2.1
Milton	J.W. & Mary Lee		DC_M2030	UCS	K.2.1
Minault	Kent		DC_M7319	UCS	K.2.1
Minaya	Christian		DC_M1208	UCS	K.2.1
Mingle	Jessica		DC_M3255	UCS	K.2.1
Minick	Jim		DC_M7194	UCS	K.2.1
Miniclier	Nicole		DC_M4136	UCS	K.2.1
Minnix	Amanda		DC_M6072	UCS	K.2.1
Minshull	Jeremy		DC_M1259	UCS	K.2.1
Minshull	Jeremy		DC_M5305	UCS	K.2.1
Mirabella	Joe		DC_E0365		K.2.2
Miramontes-Johnson	DaniLe		DC_M7494	UCS	K.2.1
Miranda	Denicolai		DC_M1649	UCS	K.2.1
Mirantz	Dorothy		DC_M2520	UCS	K.2.1
Misirlic	Lola		DC_M4350	UCS	K.2.1
Misner	Anthony		DC_M6186	UCS	K.2.1
Misner	Meredith		DC_M7149	UCS	K.2.1
Mitchel	Sharon A.		DC_M4356	UCS	K.2.1
Mitchell	Alrlene		DC_M3001	UCS	K.2.1
Mitchell	Barbara		DC_M6989	UCS	K.2.1
Mitchell	Colin		DC_E0321		K.2.2
Mitchell	Margaret		DC_M2748	UCS	K.2.1
Mitchell	Mary		DC_M0849	UCS	K.2.1
Mitchell	Pauline		DC_E0374	Campaign for International Co-operation and Disarmament	K.3.1, K.3.2, K.3.7, K.3.11, K.3.12, K.3.13, K.3.15
Mitchell	Rosamond		DC_M1934	UCS	K.2.1
Mitchell	Rosamond		DC_M1935	UCS	K.2.1
Mitchell	Sheri		DC_M5934	UCS	K.2.1
Mitchell	Tony		DC_M5131	UCS	K.2.1
Mitman	Tammalene		DC_M2496	UCS	K.2.1
Mitton	Darren		DC_M7155	UCS	K.2.1
Mizell	Mike		DC_M7661	UCS	K.2.1

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Mo	Donna		DC_M7571	UCS	K.2.1
Mock	Jean		DC_M6653	UCS	K.2.1
Moe	John		DC_M7657	UCS	K.2.1
Moehle	Henry		DC_M5293	UCS	K.2.1
Moeller	Mary		DC_M7198	UCS	K.2.1
Moeller	Valerie		DC_M2371	UCS	K.2.1
Moeller	Valerie		DC_M2385	UCS	K.2.1
Moench	Heather		DC_M0748		K.2.1
Mogen	Ayako		DC_M5761	UCS	K.2.1
Mohlman	Ambur		DC_M0316		K.2.1
Mohn	Corey		DC_M2584	UCS	K.2.1
Mohr	Alexis		DC_M1915	UCS	K.2.1
Mohr	Alexis		DC_M3593	UCS	K.2.1
Moidel	Jeffrey		DC_M2975	UCS	K.2.1
Moir	David W.		DC_M6422	UCS	K.2.1
Mojica	L.		DC_M0508		K.2.1
Molchan-Fitzgerald	Nan		DC_M1732	UCS	K.2.1
Mollenhauer	Paul		DC_M7785		K.2.1
Molnar	Nollie		DC_M4966	UCS	K.2.1
Molnar	Nollie		DC_M6858	UCS	K.2.1
Molyneaux	Kathie		DC_M6250	UCS	K.2.1
Momsen	Eric		DC_M1914	UCS	K.2.1
Monahan	Carol		DC_M5582	UCS	K.2.1
Monahan	John		DC_M6515	UCS	K.2.1
Monasky	Michael		DC_PHO0024		K.3.1, K.3.2, K.3.15, K.4
Mondschein	Elizabeth		DC_M6688	UCS	K.2.1
Mone	Carolyn		DC_M5046	UCS	K.2.1
Montague	Susan		DC_M6148	UCS	K.2.1
Montalvo	Monica		DC_M2581	UCS	K.2.1
Montana	Peter		DC_M2250	UCS	K.2.1
Montelleon	Marjorie		DC_M4513	UCS	K.2.1
Montgomery	Charles		DC_M2910	UCS	K.2.1
Montore	Michael		DC_M1651	UCS	K.2.1
Mood	Patricia		DC_M4706	UCS	K.2.1
Moon	Carolyn		DC_M1129	UCS	K.2.1
Moon	Maryann		DC_M2452	UCS	K.2.1
Mooney	Sara		DC_M3184	UCS	K.2.1
Moor	Gary R.		DC_M1044	UCS	K.2.1
Moore	Elizabeth Davis		DC_M1128	UCS	K.2.1
Moore	Evelyn		DC_M3071	UCS	K.2.1
Moore	Gwendolyn		DC_M5960	UCS	K.2.1
Moore	Kelly		DC_M3537	UCS	K.2.1
Moore	Kristine Stroad		DC_M4953	UCS	K.2.1
Moore	Leann		DC_M6389	UCS	K.2.1
Moore	Linda		DC_M4550	UCS	K.2.1
Moore	Lorian		DC_M3738	UCS	K.2.1
Moore	Lynne		DC_M6147	UCS	K.2.1
Moore	Margaret		DC_M3943	UCS	K.2.1
Moore	Sharon		DC_M3493	UCS	K.2.1
Moore	Sherrie		DC_M4446	UCS	K.2.1
Moore	Tammy		DC_M5230	UCS	K.2.1
Moore	Tom		DC_M7773		K.2.1
Moore	Kathleen		DC_M1746	UCS	K.2.1
Moore-Ortiz	Cheryl		DC_M1661	UCS	K.2.1
Morales	Carmen		DC_M2127	UCS	K.2.1
Moran	Kathleen		DC_M2824	UCS	K.2.1
Morarre	Thomas A		DC_M2289	UCS	K.2.1
Moravitz	Stefanie		DC_M4351	UCS	K.2.1

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Morawitz	Terry		DC_M6822	UCS	K.2.1
Mordan	William		DC_M1532	UCS	K.2.1
Moreau	Jacqueline		DC_M0799	UCS	K.2.1
Moreira	Nancy		DC_M7327	UCS	K.2.1
Morello	Phyl		DC_M1175	UCS	K.2.1
Moreno	Gilbert		DC_M0735		K.2.1
Moreno	Heidi		DC_M4812	UCS	K.2.1
Moreton	Marion		DC_M0821	UCS	K.2.1
Moreton	Marion		DC_M1001	UCS	K.2.1
Morgan	David		DC_M1280	UCS	K.2.1
Morgan	Jane		DC_M7162	UCS	K.2.1
Morgan	Kathryn		DC_M1243	UCS	K.2.1
Morgan	Marianne		DC_M2839	UCS	K.2.1
Morgan	Melissa		DC_M2709	UCS	K.2.1
Morgan	Michelle		DC_M6437	UCS	K.2.1
Morgan	Patricia		DC_M2854	UCS	K.2.1
Morgan	Rian		DC_M6681	UCS	K.2.1
Morgan	Susan		DC_M5810	UCS	K.2.1
Morgan	Wendy		DC_M6182	UCS	K.2.1
Morganstern	Roberta		DC_M4521	UCS	K.2.1
Morghen	Sigrit		DC_M3331	UCS	K.2.1
Moriarty	Paula		DC_M4744	UCS	K.2.1
Morin	Linda		DC_M4690	UCS	K.2.1
Morin	Lynn		DC_M4329	UCS	K.2.1
Morinville	Lynette		DC_M0622		K.2.1
Morkovsky	Mary C.		DC_M0987	UCS	K.2.1
Morley	Deborah		DC_M1467	UCS	K.2.1
morley	Julaine		DC_M6323	UCS	K.2.1
Mornel	Theodore		DC_M2693	UCS	K.2.1
Moroney	M.L.		DC_M5149	UCS	K.2.1
Moros	Fancoise		DC_M3571	UCS	K.2.1
Moroz	Lela		DC_M6862	UCS	K.2.1
Moroz	Vira		DC_M4717	UCS	K.2.1
Morr	Dirk		DC_M2658	UCS	K.2.1
Morrel-Samuels	Palmer		DC_E0325		K.3.1, K.3.2
Morrill	Douglas		DC_M3824	UCS	K.2.1
Morris	Billie		DC_M3218	UCS	K.2.1
Morris	Lynne		DC_M3938	UCS	K.2.1
Morris	Michael		DC_M4602	UCS	K.2.1
Morris	Ray		DC_M5530	UCS	K.2.1
Morris	Sean		DC_E0344	Menwith Hill Forum	K.2.2
Morris	Sharon		DC_M4301	UCS	K.2.1
Morrisey	Michael		DC_M3679	UCS	K.2.1
Morrison	Catherine		DC_M0956	UCS	K.2.1
Morrison	Courtney		DC_M2465	UCS	K.2.1
Morrison	Donald		DC_M7593	UCS	K.2.1
Morrison	Halle		DC_M0137		K.2.1
Morrison	Jerry		DC_E0440		K.3.14
Morrison	Kristofor		DC_M3937	UCS	K.2.1
Morrison	Lara		DC_PHO0027		K.3.3, K.3.13, K.3.15, K.3.18
Morrison	Margaret		DC_M0212		K.3.14
Morrison	Mary Lou		DC_M7910		K.2.1
Morrison	Susan		DC_M2183	UCS	K.2.1
Morrison	Wendy		DC_M2166	UCS	K.2.1
Morrow	Panny A		DC_M2353	UCS	K.2.1
Morrow	Quenby		DC_M5542	UCS	K.2.1
Morrow	Thomas E.		DC_M1228	UCS	K.2.1
Morse	Kathryn		DC_M2791	UCS	K.2.1
Morse	Penney		DC_M0361		K.2.1

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Mortellaro	Robert		DC_M2623	UCS	K.2.1
Mortenson	Darlene		DC_M2761	UCS	K.2.1
Mortenson	Joan		DC_M5975	UCS	K.2.1
Morton	Martha		DC_M7539	UCS	K.2.1
Moscicki	Natalia		DC_M5714	UCS	K.2.1
Moseley	Ray		DC_M2999	UCS	K.2.1
Moser	Hans-Rudolf		DC_M6053	UCS	K.2.1
Moser	Judy		DC_M3425	UCS	K.2.1
Moses	H.R.		DC_M5708	UCS	K.2.1
Mosher	Allyn		DC_M2478	UCS	K.2.1
Mosher	Craig		DC_M4330	UCS	K.2.1
Mosher	Holly		DC_M7605	UCS	K.2.1
Mosher	Scott		DC_M5657	UCS	K.2.1
Mosier	Gretchen		DC_M3330	UCS	K.2.1
Mosket	Jef		DC_M2130	UCS	K.2.1
Moss	Laurel		DC_M2938	UCS	K.2.1
Moss	Laurel		DC_M5607	UCS	K.2.1
Mossman	Jake		DC_M3284	UCS	K.2.1
Mott	Ashleigh		DC_M3962	UCS	K.2.1
Mott	Carolyn		DC_M1165	UCS	K.2.1
Motyka	Mark		DC_M7232	UCS	K.2.1
Mouer	Sylvia		DC_M4459	UCS	K.2.1
Moulton	Paul Charbonnet		DC_E0126		K.2.2
Moxley	Diana		DC_M7460	UCS	K.2.1
Moyer	Hariet		DC_M3567	UCS	K.2.1
Moyher	Joan		DC_M3017	UCS	K.2.1
Mrozinski	Debbie		DC_M1556	UCS	K.2.1
Muehlenkamp	Angel		DC_M2569	UCS	K.2.1
Muehlenkamp	Angel		DC_M6291	UCS	K.2.1
Mueller	Debra		DC_M6959	UCS	K.2.1
Mueller	Karsten		DC_M3993	UCS	K.2.1
Mueller	Kurt-Charles		DC_M0863	UCS	K.2.1
Mugge	Paul		DC_M2086	UCS	K.2.1
Mujica	Juliana		DC_M7199	UCS	K.2.1
Mukada	Maraid		DC_M4922	UCS	K.2.1
Mukavetz	Megan		DC_M2157	UCS	K.2.1
Mull	Dave		DC_E0353		K.3.16
Mullane	Danny		DC_M7110	UCS	K.2.1
Mullane	Sharon		DC_M0950	UCS	K.2.1
Mullen	George		DC_M0406		K.2.1
Muller	Don		DC_M5394	UCS	K.2.1
Muller	Peter		DC_M0708		K.2.1
Mulligan	Dana		DC_M3347	UCS	K.2.1
Mulligan	Michael		DC_M5178	UCS	K.2.1
Mulligan	Ruth J.		DC_M6128	UCS	K.2.1
Mullins	Jeff		DC_M7523	UCS	K.2.1
Muniz	Rich		DC_M3564	UCS	K.2.1
Munro	Karen		DC_M0689		K.2.1
Munson	Jacob		DC_M6446	UCS	K.2.1
Munson	Peter		DC_M1893	UCS	K.2.1
Murdock	Linda		DC_M5725	UCS	K.2.1
Murphy	Daniel		DC_M5519	UCS	K.2.1
Murphy	Dennis		DC_M4017	UCS	K.2.1
Murphy	Doris		DC_M3183	UCS	K.2.1
Murphy	Doris		DC_M3572	UCS	K.2.1
Murphy	Elizabeth		DC_M4795	UCS	K.2.1
Murphy	Esther		DC_M4769	UCS	K.2.1
Murphy	Garrett		DC_M7447	UCS	K.2.1
Murphy	Jean		DC_M5228	UCS	K.2.1

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Murphy	John D.		DC_E0202	Jesuit Community Santa Clara University	K.2.4
Murphy	Karen		DC_M7676	UCS	K.2.1
Murphy	Marilyn		DC_M6171	UCS	K.2.1
Murphy	Michael		DC_M7113	UCS	K.2.1
Murphy	Peg Boucher		DC_M7081	UCS	K.2.1
Murphy	Stephen		DC_M2280	UCS	K.2.1
Murphy	Susan		DC_M3704	UCS	K.2.1
Murphy	Timothy		DC_M6954	UCS	K.2.1
Murr	Bobbee		DC_M0479		K.2.1
Murray	Karen		DC_PHO0060		K.3.12
Murray	Linda		DC_M0482		K.2.1
Murray	Mark		DC_M7808		K.3.17
Murtha	Sharon		DC_M1598	UCS	K.2.1
Muse	Philip		DC_E0234		K.2.3
Muser	Mary		DC_M5836	UCS	K.2.1
Musial	Kim		DC_M3842	UCS	K.2.1
Musialowski	Susan		DC_M4856	UCS	K.2.1
Musser	Marcie		DC_M5098	UCS	K.2.1
Musson	Maureen		DC_M2834	UCS	K.2.1
Muto	Kris		DC_M2274	UCS	K.2.1
Muzzy	Coralie		DC_E0361		K.2.3
Myer	Scott		DC_M0257		K.2.1
Myers	Adele		DC_M6177	UCS	K.2.1
Myers	Amie		DC_M5089	UCS	K.2.1
Myers	David		DC_M4245	UCS	K.2.1
Myers	George		DC_M2446	UCS	K.2.1
Myers	Natasha		DC_E0012		K.2.2
Myers	Pamela		DC_M4726	UCS	K.2.1
Myers	Robert		DC_M3708	UCS	K.2.1
Myers	Susan		DC_M6617	UCS	K.2.1
Myers	Sylvia		DC_M3025	UCS	K.2.1
Myers	Victoria		DC_M6514	UCS	K.2.1
Mykoff	Robert		DC_M7347	UCS	K.2.1
Myles	Sarah		DC_M6366	UCS	K.2.1
Naccarato	Grace		DC_M0168		K.3.14
Nacheff	Marni		DC_M2708	UCS	K.2.1
Naclerio	Lynda		DC_M2954	UCS	K.2.1
Nadelman	Fred		DC_M1468	UCS	K.2.1
Nadelman	Fred		DC_M5330	UCS	K.2.1
Naeseth	Joan		DC_M5367	UCS	K.2.1
Nagendra	Saray		DC_M5848	UCS	K.2.1
Nagle	Rob		DC_M3747	UCS	K.2.1
Nagy	Mary Jo		DC_M6846	UCS	K.2.1
Nam	S.		DC_M7427	UCS	K.2.1
Napoleon	Laura		DC_M2363	UCS	K.2.1
Narang	Vikrant		DC_E0415		K.3.1, K.3.4, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15
Narveson	Robert		DC_M6019	UCS	K.2.1
Nasbaum	Cyndi		DC_M4507	UCS	K.2.1
Nash	Andrew		DC_M0245		K.2.2
Nash	Chelsea		DC_M0475		K.2.1
Nash	Chelsea		DC_M3513	UCS	K.2.1
Nasif	Maria		DC_M5615	UCS	K.2.1
Nason	Zena		DC_M3344	UCS	K.2.1
Nassikas	Chris		DC_M4408	UCS	K.2.1
Nassiri-Rahimi	Roya		DC_M1593	UCS	K.2.1
Nassrine	Farhoody		DC_M3578	UCS	K.2.1

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Nast	John		DC_M4897	UCS	K.2.1
Natali	Steven		DC_M7787		K.3.1, K.3.7
Natarajan	Soundaran		DC_M5193	UCS	K.2.1
Natarajan	Soundaran		DC_M6793	UCS	K.2.1
Nativi	Lisa		DC_M3477	UCS	K.2.1
Natvig	Carol		DC_M3506	UCS	K.2.1
Naujokas	Deborah		DC_M3336	UCS	K.2.1
Naujokas	Ginto		DC_M3335	UCS	K.2.1
Naurath	David		DC_M2027	UCS	K.2.1
Navarra	Nancy		DC_M5953	UCS	K.2.1
Navarrete	Jennifer Shaw		DC_M3194	UCS	K.2.1
Navarrete	Patty		DC_M0600		K.2.1
Nave	Sally		DC_M3179	UCS	K.2.1
Naylor	Elisha		DC_M2953	UCS	K.2.1
Nazari	Mohsen		DC_M6133	UCS	K.2.1
Neace	Mb		DC_M1655	UCS	K.2.1
Neace	Mb		DC_M7072	UCS	K.2.1
Neale	Colin		DC_M4544	UCS	K.2.1
Nealon	Sandra		DC_M4861	UCS	K.2.1
Nealy	Carol		DC_M4545	UCS	K.2.1
Nebitt	Dale		DC_E0366	East Bay Peace Action	K.3.1, K.3.2, K.3.3, K.3.6, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Needham	Meredith		DC_M2950	UCS	K.2.1
Needs	Steven		DC_M3712	UCS	K.2.1
Neff	Grace		DC_M4996	UCS	K.2.1
Neff	Joanna		DC_M0756		K.2.1
Neff	Samuel		DC_M0323		K.2.1
Neff	Ted		DC_E0133		K.2.3
Nefstead	Margaret		DC_E0078		K.3.3, K.3.4
Neidell	Merle		DC_M6135	UCS	K.2.1
Neidich	Theresa Donatiello		DC_M7548	UCS	K.2.1
Neil	Linda		DC_M7203	UCS	K.2.1
Neimark	M.S.		DC_M7184	UCS	K.2.1
Nelson	Carol		DC_M3486	UCS	K.2.1
Nelson	Cris		DC_M7879		K.2.1
Nelson	George		DC_M6410	UCS	K.2.1
Nelson	James		DC_M5226	UCS	K.2.1
Nelson	Janet		DC_M2039	UCS	K.2.1
Nelson	Kanoa		DC_PHO0053		K.3.15
Nelson	Kathleen		DC_M5797	UCS	K.2.1
Nelson	Kristie		DC_M7850		K.2.3
Nelson	Pam		DC_M1385	UCS	K.2.1
Nelson	Thomas		DC_M6645	UCS	K.2.1
Nerode	Gregory		DC_M0484		K.2.1
Nestlinger	Alan		DC_M3643	UCS	K.2.1
Neswald	Barbara		DC_M2530	UCS	K.2.1
Neu	Cy		DC_M3237	UCS	K.2.1
Neu	Gary		DC_M3162	UCS	K.2.1
Neuberger	Egon		DC_M3686	UCS	K.2.1
Neumann	Elizabeth		DC_M6476	UCS	K.2.1
Neumeyer	Debbie L.		DC_M0120		K.2.1
Neuzil	Denise		DC_M1321	UCS	K.2.1
Neville	Polly		DC_M3394	UCS	K.2.1
Neville	Willis		DC_M1664	UCS	K.2.1
New	Andrea		DC_M6241	UCS	K.2.1
New	Marianne		DC_M3645	UCS	K.2.1
Newberg	Stephen		DC_M1943	UCS	K.2.1

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Newberry	Roxie		DC_M7603	UCS	K.2.1
Newcomer	Kayly		DC_M4418	UCS	K.2.1
Newkirk	Lindsey		DC_M6317	UCS	K.2.1
Newland	Jane		DC_M1870	UCS	K.2.1
Newman	Alicia		DC_M3716	UCS	K.2.1
Newman	Rae		DC_M4870	UCS	K.2.1
Newman	Sarah		DC_M3072	UCS	K.2.1
Newman-Jennison	Julie		DC_M6762	UCS	K.2.1
Newman-Smith	Ann		DC_M6875	UCS	K.2.1
Newsom	Marcia		DC_M2947	UCS	K.2.1
Newsom	Scott		DC_M3614	UCS	K.2.1
Newsom	Teri		DC_M4015	UCS	K.2.1
Newton	Elizabeth		DC_M4823	UCS	K.2.1
Newton	Peter		DC_M0922	UCS	K.2.1
Nguyen	Andrew		DC_M4164	UCS	K.2.1
Nguyen	Tuan-Linh		DC_M1643	UCS	K.2.1
Niblack	Catharine		DC_M3223	UCS	K.2.1
Niccoli	Cheryl		DC_M0003		K.3.2, K.3.12
Nicholas	Patricia		DC_M3100	UCS	K.2.1
Nicholas	Steve		DC_M3701	UCS	K.2.1
Nichols	Allan		DC_M5087	UCS	K.2.1
Nichols	Randilea		DC_M6581	UCS	K.2.1
Nichols	William		DC_M0302		K.2.1
Nichols	William		DC_M1471	UCS	K.2.1
Nichols	William		DC_M5161	UCS	K.2.1
Nicholson	David		DC_E0056		K.3.1, K.3.2, K.3.7, K.3.10, K.3.15
Nicholson-Schenk	Marguerite		DC_M6444	UCS	K.2.1
Nickels	Charlene		DC_M7019	UCS	K.2.1
Nickerson	Bradford		DC_M4469	UCS	K.2.1
Nickerson	Dan		DC_M3304	UCS	K.2.1
Nicklaus	Christine		DC_M0439		K.2.1
Nicolow	Jim		DC_M6359	UCS	K.2.1
Nicols	Colin		DC_M3130	UCS	K.2.1
Nicosia	Chris		DC_M6535	UCS	K.2.1
Nielsen	Benjamin		DC_M7789		K.2.3
Nienkark	Shirley		DC_M6808	UCS	K.2.1
Nierhaus	Florian		DC_M3000	UCS	K.2.1
Niernberger	Jana Webb		DC_M6812	UCS	K.2.1
Nigro	Janice		DC_M6302	UCS	K.2.1
Nihipali	Michele		DC_M1060	UCS	K.2.1
Niksic	Joyce		DC_M5574	UCS	K.2.1
Nisinson	Carolyn		DC_M5422	UCS	K.2.1
Nisinson	Carolyn		DC_M5423	UCS	K.2.1
Nissley	Connie		DC_M7889		K.2.1
Nivola	Che		DC_M0097		K.3.1, K.3.2, K.3.4, K.3.5, K.3.10
Noah	Ian		DC_M5551	UCS	K.2.1
Noah	Sandra		DC_M0520		K.2.1
Nocella	Scott		DC_M3178	UCS	K.2.1
Noda	Robin		DC_M1126	UCS	K.2.1
Nodel	Fred		DC_M7301	UCS	K.2.1
Noel	John		DC_M0848	UCS	K.2.1
Noel	John		DC_M2790	UCS	K.2.1
Noel	Lee		DC_M2962	UCS	K.2.1
Noethen	Mark		DC_M4567	UCS	K.2.1
Nolan	Anmorya		DC_M4508	UCS	K.2.1
Nolan	Antoinette		DC_M7163	UCS	K.2.1
Nolan	John		DC_M6280	UCS	K.2.1

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Nolte	Linda		DC_M3835	UCS	K.2.1
Noon	Rev Dr Wendy		DC_M2015	UCS	K.2.1
Noon	Rev Dr Wendy		DC_M2016	UCS	K.2.1
Noon	Rev Dr Wendy		DC_M2017	UCS	K.2.1
Noon	Wendy Yona		DC_M0677		K.2.1
Noon	Wendy Yona		DC_M4282	UCS	K.2.1
Noon	Wendy Yona		DC_M4284	UCS	K.2.1
Nord	Jill A.		DC_M0412		K.2.1
Nordberg	Heidi		DC_M5343	UCS	K.2.1
Norddahl	Birgir		DC_M1000	UCS	K.2.1
Nordquist	Susan		DC_M7876		K.2.1
Nordskog	Aubrie		DC_M2142	UCS	K.2.1
Norell	Judith		DC_M6814	UCS	K.2.1
Norian	Lyse		DC_M7764		K.2.1
Norman	Chris		DC_M2955	UCS	K.2.1
Norman	Sonya		DC_M0437		K.2.1
Norman	Tyler		DC_M7214	UCS	K.2.1
Norris	Brian		DC_M4011	UCS	K.2.1
Norris	Susan		DC_M5381	UCS	K.2.1
Norris	Wendy		DC_M7156	UCS	K.2.1
Norsen	Evelyn		DC_P0005		K.3.1, K.3.2, K.3.3, K.3.10, K.3.13
North	Elizabeth		DC_M5955	UCS	K.2.1
North	Harry		DC_M4752	UCS	K.2.1
North	Sheryl		DC_M7851		K.2.1
Norton	Nicholas		DC_M3135	UCS	K.2.1
Not Given	Nina		DC_M6379	UCS	K.2.1
Nottingham	Ashley		DC_M1874	UCS	K.2.1
Novak	Kurt		DC_M1123	UCS	K.2.1
Novak	Trina		DC_M7592	UCS	K.2.1
Novick	Mindy		DC_E0307		K.2.2
Novkov	Russell		DC_M3121	UCS	K.2.1
Nowicki	Kristen		DC_M1831	UCS	K.2.1
Ntiz	Jen		DC_M1672	UCS	K.2.1
Nuess	Mike		DC_M7140	UCS	K.2.1
Nuffer	Paul		DC_M6465	UCS	K.2.1
Nugent	Jaip		DC_M3886	UCS	K.2.1
Nun	Marion		DC_M4005	UCS	K.2.1
Nunes	David		DC_M3043	UCS	K.2.1
Nunes	Lisa		DC_M0529		K.2.1
Nunes	Lisa		DC_M1325	UCS	K.2.1
Nunez	Carlos A.		DC_M5581	UCS	K.2.1
Nunez-Hinestrosa	Julio E.		DC_M0934	UCS	K.2.1
Nunlist	Kathy		DC_M2540	UCS	K.2.1
Nunneker	Amy		DC_M5979	UCS	K.2.1
Nuria	Rodriguez		DC_M7724		K.2.1
Nuytinck	Pieter		DC_M2934	UCS	K.2.1
Nwokoye	Anne		DC_M7181	UCS	K.2.1
Nyborg	Yvonne		DC_M5613	UCS	K.2.1
Nystrom	Mark		DC_M4684	UCS	K.2.1
O' Brian	Frances		DC_M3112	UCS	K.2.1
O' Brian	ME		DC_M2042	UCS	K.2.1
O' Quinn	Garland		DC_M2364	UCS	K.2.1
O.	C.		DC_M6583	UCS	K.2.1
Oakes	Jacqueline		DC_M1148	UCS	K.2.1
Oaklander	Violet		DC_M0138		K.2.1
Oakley	Charmaine		DC_M4868	UCS	K.2.1
Oaks	Lucy		DC_M7007	UCS	K.2.1
Oates	Noel		DC_M2054	UCS	K.2.1

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Oberbillig	Molly		DC_M6869	UCS	K.2.1
Oberlander	Jane		DC_M6800	UCS	K.2.1
Obermeier	Anita		DC_M7547	UCS	K.2.1
Oberzut	Carlotta		DC_M5472	UCS	K.2.1
Obeso	Angela		DC_M6678	UCS	K.2.1
Oblas	Ella H.		DC_M6930	UCS	K.2.1
Obler	Paul		DC_M0317		K.2.1
Obrian	Dorothy		DC_M2021	UCS	K.2.1
O'Brien	Florcence		DC_M5695	UCS	K.2.1
O'Brien	Frances		DC_M0741		K.2.1
O'Brien	M.E.		DC_M1260	UCS	K.2.1
O'brien	Melissa		DC_M6295	UCS	K.2.1
O'Brien	Theresa		DC_M4278	UCS	K.2.1
Obuszewski	Max		DC_E0020		K.2.2
Ochal	Melissa		DC_M3276	UCS	K.2.1
Ochoa	Gilbert		DC_M3299	UCS	K.2.1
Oclott	Betty		DC_M2389	UCS	K.2.1
O'Connor	Gary		DC_M2006	UCS	K.2.1
O'Connor	Monica		DC_M1700	UCS	K.2.1
Odell	Dena		DC_M7312	UCS	K.2.1
Odell	Ken		DC_M7414	UCS	K.2.1
Odonnell	Amy		DC_M1106	UCS	K.2.1
O'Donnell	Ann		DC_M5523	UCS	K.2.1
O'Donnell	Barbara		DC_M2728	UCS	K.2.1
O'Donnell	Dawn		DC_M2403	UCS	K.2.1
O'Donnell	Julie		DC_M6116	UCS	K.2.1
O'Drobinak	John		DC_M3401	UCS	K.2.1
Oehlman	Gloria		DC_M7060	UCS	K.2.1
Offield	Doug		DC_M5256	UCS	K.2.1
Ogas	Daniel		DC_M4213	UCS	K.2.1
Ogletree	Wanda		DC_M5474	UCS	K.2.1
Ogren	Lorrie		DC_M6209	UCS	K.2.1
Ogren	Mike		DC_M7653	UCS	K.2.1
Ohaire	Hugh		DC_M2075	UCS	K.2.1
O'Halloran	James		DC_M2528	UCS	K.2.1
O'Halloran	James		DC_M5281	UCS	K.2.1
O'Hara	David		DC_M1776	UCS	K.2.1
Okazaki	Laura		DC_M1053	UCS	K.2.1
O'Keefe	Leanne		DC_M1845	UCS	K.2.1
O'Kelley	Donald		DC_M0840	UCS	K.2.1
O'Kennedy	Elaine		DC_M3029	UCS	K.2.1
Oklander	Martha		DC_M0176		K.2.1
Okstel	Carol		DC_M6024	UCS	K.2.1
Olch	Paula		DC_E0434	4201 E. Monte Vista #G106 Tucson, AZ 85712	K.3.1, K.3.14
Olch	Paula J.		DC_M0386		K.2.1
O'Leary	Kathryn		DC_M0478		K.2.1
Olejniczak	Anne		DC_M4546	UCS	K.2.1
Oleskevich	Diana		DC_E0267	Sisters of St. Joseph of Carondelet	K.2.2
Oleskevich	Diana-Jim		DC_E0416		K.3.1, K.3.2, K.3.3, K.3.4, K.3.7, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15
Oliva	Anthony		DC_M2275	UCS	K.2.1
Oliver	Della		DC_M6791	UCS	K.2.1
Oliver	Grace		DC_M3338	UCS	K.2.1
Olivieri	Jennifer		DC_M3920	UCS	K.2.1
Olivieri	Jennifer		DC_M3942	UCS	K.2.1

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Ollis	Jessica		DC_M2406	UCS	K.2.1
Olsen	Eileen		DC_M5509	UCS	K.2.1
Olsen	Webster		DC_M6694	UCS	K.2.1
Olson	Dorothy		DC_M7305	UCS	K.2.1
Olson	Gary		DC_M2686	UCS	K.2.1
Olson	Kurt N.		DC_M1949	UCS	K.2.1
Olson	Rod	Carol Olson	DC_M4910	UCS	K.2.1
Olson	Ruth		DC_M4047	UCS	K.2.1
Olson	Sara		DC_M6553	UCS	K.2.1
Olstein	Deborah		DC_M2578	UCS	K.2.1
Olver	Martha		DC_M3400	UCS	K.2.1
Om	Joy		DC_M3055	UCS	K.2.1
Omdalen	Ruth		DC_M7150	UCS	K.2.1
Oneal	Terry		DC_M7563	UCS	K.2.1
O'Neal	Joan B.		DC_M5383	UCS	K.2.1
O'Neal	Megan		DC_M7125	UCS	K.2.1
O'Neil	Brigid		DC_M7242	UCS	K.2.1
Oneill	Brian		DC_M0477		K.2.1
O'Neill	John		DC_M1987	UCS	K.2.1
Ong	Wen		DC_M1179	UCS	K.2.1
O'Niel	Lyn		DC_M6787	UCS	K.2.1
Onorato	John		DC_M4677	UCS	K.2.1
Opfer	Mary Alice		DC_M1630	UCS	K.2.1
Opipari	Linda		DC_M1109	UCS	K.2.1
Opton	Edward		DC_M6087	UCS	K.2.1
Ordonez	Richard		DC_M0381		K.2.1
Ordway	William		DC_M1255	UCS	K.2.1
Orffeo	Joseph		DC_M0643		K.2.1
Orians	Gordon		DC_M1899	UCS	K.2.1
Orliner	Robin		DC_M6540	UCS	K.2.1
Orndorff	Jerry		DC_M6696	UCS	K.2.1
Ornduff	JoEllen		DC_M6371	UCS	K.2.1
Orne	Richard		DC_M7285	UCS	K.2.1
Orr	Jenny		DC_M5538	UCS	K.2.1
Orr	Pam		DC_M2920	UCS	K.2.1
Orsary	Stephen		DC_M7623	UCS	K.2.1
Ortega	Ana		DC_M1427	UCS	K.2.1
Ortega	Lulu		DC_M1058	UCS	K.2.1
Ortiz	Barbie		DC_M7278	UCS	K.2.1
Ortiz	Joseph		DC_E0369		K.2.3
Ortlip	Jason		DC_M1398	UCS	K.2.1
Orwick	Clark		DC_M7901		K.3.1, K.3.2, K.3.10
Osborn	Nic		DC_M5563	UCS	K.2.1
Osborn	Rex		DC_M0397		K.2.1
Osborne	Kim		DC_M0888	UCS	K.2.1
Osborne	Olga		DC_M1981	UCS	K.2.1
Oshiro	Barry		DC_M4283	UCS	K.2.1
Osisek	Damian		DC_M1554	UCS	K.2.1
Osowecki	Steve		DC_M6316	UCS	K.2.1
Oster	Harriet s.		DC_M1600	UCS	K.2.1
Ostrand	Susan Linn		DC_M0121		K.2.1
Ostrander	Carolyn		DC_M0089		K.2.1
Ostrander	Marie		DC_M6442	UCS	K.2.1
Oswald	Lesley		DC_M2388	UCS	K.2.1
Ottenberg	Marjorie		DC_M3109	UCS	K.2.1
Ottersberg	Steve		DC_M7716		K.2.3
Ottina-Cserr	Tracy		DC_M1465	UCS	K.2.1
Otto	Brent		DC_E0159		K.2.3
Ouellette	Tracy		DC_M1013	UCS	K.2.1

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Overhiser	Elizabeth		DC_M3510	UCS	K.2.1
Overholt	Roger		DC_M2674	UCS	K.2.1
Overstreet	Jan		DC_M5240	UCS	K.2.1
Overton	Hans		DC_M1192	UCS	K.2.1
Oviat	Stephen		DC_M0411		K.2.1
Ow	Sandra		DC_M1633	UCS	K.2.1
Owen	A.J.		DC_M0532		K.2.1
Owen	Benjamin		DC_M1982	UCS	K.2.1
Owen	Douglass		DC_M1910	UCS	K.2.1
Owen	J.		DC_M4365	UCS	K.2.1
Owen	Jim		DC_M4489	UCS	K.2.1
Owens	Brenda		DC_M6272	UCS	K.2.1
Owens	Carly		DC_M4944	UCS	K.2.1
Owens	Dwight		DC_M6961	UCS	K.2.1
Owens	Gail		DC_M5328	UCS	K.2.1
Owens	Gary		DC_M2850	UCS	K.2.1
Owens	Sharon E.		DC_M1007	UCS	K.2.1
Owens	Susan		DC_M5191	UCS	K.2.1
Owings	Kathleen		DC_M6489	UCS	K.2.1
Oxyer	Jim		DC_M5513	UCS	K.2.1
Ozer	Alan		DC_M1371	UCS	K.2.1
P	C.N.		DC_M2697	UCS	K.2.1
P	Mara		DC_M5054	UCS	K.2.1
Paatrey	Jonathan		DC_PHO0023	Physicians for Social Responsibility	K.3.9, K.4
Packer	Iaila		DC_E0091		K.3.3, K.3.12, K.3.13
Paden	Dori		DC_M6115	UCS	K.2.1
Paden	Dori A.		DC_M5209	UCS	K.2.1
Padfield	Clare		DC_M2600	UCS	K.2.1
Paez	Tim		DC_M6497	UCS	K.2.1
Pagano	Cathy		DC_M4051	UCS	K.2.1
Page	Robert		DC_M7076	UCS	K.2.1
Pagliaro	Raymond		DC_M1279	UCS	K.2.1
Paine	Paul		DC_M6448	UCS	K.2.1
Pais	Julia		DC_M0517		K.2.1
Paisley	Anne		DC_M3031	UCS	K.2.1
Paldi	Nana J.		DC_M1818	UCS	K.2.1
Paley	Shawn A		DC_M7029	UCS	K.2.1
Palma-Glennie	Janice		DC_M7087	UCS	K.2.1
Palmer	John		DC_E0160		K.3.2, K.3.7, K.3.10, K.3.14
Palmer	Kirstie		DC_M6215	UCS	K.2.1
Palmer	Mara		DC_M1390	UCS	K.2.1
Palmer	Noel		DC_E0251		K.3.2, K.3.3, K.3.12, K.3.15
Palrud	Robert		DC_M1546	UCS	K.2.1
Palumbo	Matt		DC_M3555	UCS	K.2.1
Pamela	G.		DC_M3948	UCS	K.2.1
Panelli	Andrew		DC_M5355	UCS	K.2.1
Pann	Robert		DC_M3760	UCS	K.2.1
Panna	Panna		DC_M2901	UCS	K.2.1
Pantelidou	Kiriaki		DC_M2365	UCS	K.2.1
Pape	Louise		DC_M6931	UCS	K.2.1
Papelardo	Beverly		DC_M1226	UCS	K.2.1
Papelardo	Beverly		DC_M5923	UCS	K.2.1
Papke	Carolyn		DC_M6203	UCS	K.2.1
Paquette	Joyce		DC_M7862		K.2.1
Paradise	Jack		DC_M3941	UCS	K.2.1
Paraszewski	Joseph		DC_M5318	UCS	K.2.1
Parciak	Wendy		DC_M5540	UCS	K.2.1
Pares	Ciara		DC_M6965	UCS	K.2.1

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Parfrey	Jonathan	John and Carole Kartunen, James and Christine Huben, Kevin Cody, Beverly Baird, Jane Williams, John McAndrew, Joseph Lyou, Lyle Talbot, Dennis Apel, Tensie Hernandez, Jim Murr, Luis Segui, Robert Armstrong, Cynthia Babich	DC_E0375		K.3.9
Parfrey	Jonathan		DC_E0395	Physicians for Social Responsibility	K.3.9, K.3.12, K.3.15, K.4
Parfrey	Jonathan		DC_E0425		K.4
Park	KJ		DC_M3548	UCS	K.2.1
Park	Sharyn		DC_M1842	UCS	K.2.1
Parker	Augustin		DC_M4911	UCS	K.2.1
Parker	Charlotte		DC_M7887		K.2.1
Parker	J.T.		DC_M2152	UCS	K.2.1
Parker	Jeanne		DC_M7132	UCS	K.2.1
Parker	Julie	Gary Anderson	DC_E0006		K.3.7
Parker	Julie	Gary Anderson	DC_M0966	UCS	K.2.1
Parker	Lawrence		DC_M7765		K.2.1
Parker	Melissa		DC_M5354	UCS	K.2.1
Parker	Sheryl		DC_M0573		K.2.1
Parker-Boone	Megan		DC_M3011	UCS	K.2.1
Parkinson	Mandy		DC_M1665	UCS	K.2.1
Parkinson	Robert		DC_M1898	UCS	K.2.1
Parks	Jennifer		DC_M7589	UCS	K.2.1
Parmett	Richard		DC_M0977	UCS	K.2.1
Parnay	Dana		DC_M6730	UCS	K.2.1
Paro	Roberta		DC_M2069	UCS	K.2.1
Parrillo	Monica		DC_M4297	UCS	K.2.1
Parrish	Jennifer		DC_M1380	UCS	K.2.1
Parsons	Barry		DC_E0019		K.3.1, K.3.2, K.3.4, K.3.6, K.3.7, K.3.10, K.3.12
Parsons	J.		DC_M7827		K.2.1
Parsons	Jean C.		DC_M6810	UCS	K.2.1
Parsons	Jerome		DC_M4519	UCS	K.2.1
Partenfelder	Mary		DC_M0209		K.2.1
Pasciak	Lisa		DC_M1903	UCS	K.2.1
Pascone	Romeo		DC_M6276	UCS	K.2.1
Pasichnyk	Richard		DC_M3420	UCS	K.2.1
Passmore	Loren		DC_M0392		K.2.1
Pasternack	Kathy		DC_M0729		K.2.1
Paterson	Geoff		DC_M3378	UCS	K.2.1
Patrick	A		DC_M6175	UCS	K.2.1
Patrie	Lewis		DC_E0112	Western North Carolina Physicians for Social Responsibility	K.3.2, K.3.7, K.3.10, K.3.11, K.3.12, K.3.13, K.3.14, K.3.15
Patrie	Lewis		DC_E0297	Western North Carolina Physicians for Social Responsibility	K.2.2
Patrizzi	Lee		DC_M2090	UCS	K.2.1
Patsy	Donna		DC_M4312	UCS	K.2.1
Pattanyus	Nikolas		DC_M2829	UCS	K.2.1

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Patterson	Miles		DC_E0223		K.3.1, K.3.2, K.3.13, K.3.14
Patterson	Phyllis		DC_M4341	UCS	K.2.1
Patterson	Traci		DC_M6770	UCS	K.2.1
Patton	Margaret		DC_M1715	UCS	K.2.1
Patumanoan	Nancy		DC_M3630	UCS	K.2.1
Paul	Davida		DC_M5455	UCS	K.2.1
Paul	Kay		DC_M4757	UCS	K.2.1
Paul	Linda M.		DC_M0575		K.2.1
Paul	Roalie Tyler		DC_E0204		K.3.12, K.4
Paul	Skip J.		DC_M7141	UCS	K.2.1
Pauley	Susan		DC_M3985	UCS	K.2.1
Paulk	Kelly		DC_M6495	UCS	K.2.1
Paulsen	David		DC_M1944	UCS	K.2.1
Paulsen	Thomas		DC_M1738	UCS	K.2.1
Pavley	Richard		DC_M7475	UCS	K.2.1
Paxson	Robert		DC_M3925	UCS	K.2.1
Payne	Lisa		DC_M3908	UCS	K.2.1
Payne	Richard E.		DC_M5508	UCS	K.2.1
Payton	Marick		DC_M1057	UCS	K.2.1
Peabody	Kathleen		DC_M2359	UCS	K.2.1
Peabody	William N.		DC_M4765	UCS	K.2.1
Peach	Hugh G.		DC_M1088	UCS	K.2.1
Peacock-Broyles	Trinity		DC_M5160	UCS	K.2.1
Peak	Bruce		DC_M1636	UCS	K.2.1
Pearce	Ellen		DC_M1363	UCS	K.2.1
Pearre	Benjamin		DC_M7700		K.2.1
Pearsall	Donald		DC_M2742	UCS	K.2.1
Pearson	Janet		DC_M4456	UCS	K.2.1
Pearson	Sandra		DC_M5105	UCS	K.2.1
Pease	Glenn		DC_M6069	UCS	K.2.1
Peck	Graham		DC_M6676	UCS	K.2.1
Peck	Jean		DC_M3673	UCS	K.2.1
Peckler	Leslie		DC_M6141	UCS	K.2.1
Peckner	Lloyd		DC_M3316	UCS	K.2.1
Pedelaborde	Claude		DC_M2665	UCS	K.2.1
Pedelty	Jeffrey		DC_M0805	UCS	K.2.1
Pedro	Stephanie		DC_M1854	UCS	K.2.1
Peebles	Dawn		DC_M5933	UCS	K.2.1
Peer	Barbara A.		DC_M1445	UCS	K.2.1
Peggar	Kathleen		DC_M4470	UCS	K.2.1
Pehkonen	Laura		DC_M4688	UCS	K.2.1
Peirce	Jana		DC_M2080	UCS	K.2.1
Pelletier	Joline		DC_M5936	UCS	K.2.1
Peloso	Christopher		DC_M2566	UCS	K.2.1
Peltz	William I.		DC_M6478	UCS	K.2.1
Pence	K.R.		DC_M2296	UCS	K.2.1
Pendergast	Mary		DC_M5164	UCS	K.2.1
Penninman	Vivian		DC_M4038	UCS	K.2.1
Penprase	Sharon		DC_M7403	UCS	K.2.1
Penrose	Walter D		DC_M2447	UCS	K.2.1
Peppard	Jeanne		DC_M4827	UCS	K.2.1
Percy	Lindis	Anni Rainbow	DC_E0413	Campaign for the Accountablity of American Bases (CAAB) UK	K.3.1, K.3.2, K.3.3, K.3.4, K.3.6, K.3.10, K.3.11, K.3.12, K.3.13
Perez	Luiz		DC_M4424	UCS	K.2.1
Perini	Louise		DC_M6729	UCS	K.2.1
Perkins	Guy		DC_M3362	UCS	K.2.1
Perkins	Joel		DC_M5487	UCS	K.2.1

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Perkins	Lewis		DC_M2458	UCS	K.2.1
Perkins	Marie		DC_M5997	UCS	K.2.1
Perkins	Randi		DC_M0496		K.2.1
Perkins	Tom		DC_M7330	UCS	K.2.1
Perkins	William		DC_M2651	UCS	K.2.1
Perko	John		DC_M6187	UCS	K.2.1
Perko	John		DC_M6188	UCS	K.2.1
Perko	John		DC_M6303	UCS	K.2.1
Perkus	Marion		DC_M7035	UCS	K.2.1
Perlman	Frances		DC_M0994	UCS	K.2.1
Perlman	Lori		DC_M2793	UCS	K.2.1
Perlmutter	Deborah		DC_M0809	UCS	K.2.1
Perloe	Deborah		DC_M7229	UCS	K.2.1
Perreault	Laura		DC_M0018		K.2.2
Perrotto	Dianna		DC_M0398		K.2.1
Perry	Alysia		DC_M5954	UCS	K.2.1
Perry	Debbie		DC_M3569	UCS	K.2.1
Perry	Diana		DC_M3512	UCS	K.2.1
Perry	Mary-Ellen		DC_M6613	UCS	K.2.1
Perry	S.		DC_M1119	UCS	K.2.1
Pesec	Vanessa		DC_M2056	UCS	K.2.1
Peters	Jenny		DC_M7595	UCS	K.2.1
Petersen	Jeff		DC_M5786	UCS	K.2.1
Petersen	Phyllis		DC_M2272	UCS	K.2.1
Peterson	Amy		DC_M2116	UCS	K.2.1
Peterson	Arlo	Caron Wetter	DC_M0193		K.2.1
Peterson	Christina		DC_M7791		K.2.1
Peterson	Debby		DC_M2026	UCS	K.2.1
Peterson	Eileen		DC_M5796	UCS	K.2.1
Peterson	Erika		DC_M1996	UCS	K.2.1
Peterson	Ingrid		DC_M7337	UCS	K.2.1
Peterson	Jordan		DC_M6764	UCS	K.2.1
Peterson	Julie		DC_M5245	UCS	K.2.1
Peterson	Sandy		DC_M2134	UCS	K.2.1
Peterson	Wescott		DC_M6576	UCS	K.2.1
Peterson	William		DC_M2838	UCS	K.2.1
Petkus	Diane		DC_M5809	UCS	K.2.1
Petretti	Robert		DC_M3773	UCS	K.2.1
Petricig	Kenneth		DC_M1469	UCS	K.2.1
Petrocelli	Johnny M.		DC_M0116		K.2.1
Petruzella	Gerol		DC_M4106	UCS	K.2.1
Petteway	Susan		DC_M6417	UCS	K.2.1
Pettey	C.		DC_M1262	UCS	K.2.1
Pfeifer	John		DC_M6627	UCS	K.2.1
Pfeiffer	Peter		DC_M7650	UCS	K.2.1
Pflug	Maria A.		DC_M4098	UCS	K.2.1
Phelan	John		DC_M7763		K.3.3, K.3.10, K.3.13
Phelps	James		DC_M0669		K.2.1
Phelps	Jerry		DC_M5775	UCS	K.2.1
Phelps	Priscilla		DC_M2945	UCS	K.2.1
Phillips	Anthony		DC_M6264	UCS	K.2.1
Phillips	Grace		DC_M4749	UCS	K.2.1
Phillips	Kevin		DC_M4906	UCS	K.2.1
Phillips	Michael		DC_M4253	UCS	K.2.1
Phillips	Pamela		DC_M4721	UCS	K.2.1
Phillips	Patricia		DC_M5879	UCS	K.2.1
Phillips	Susan		DC_E0072		K.2.2
Phillips	Thomas		DC_M0971	UCS	K.2.1
Phillips	Tomi		DC_M4143	UCS	K.2.1

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Phillips-Gutchell	Evelyn		DC_M6509	UCS	K.2.1
Philpot	J.		DC_M6144	UCS	K.2.1
Phinney	Ruth		DC_M2424	UCS	K.2.1
Phipps	Ma		DC_M1091	UCS	K.2.1
Phipps	Michael		DC_E0035		K.2.2
Photinos	Janet		DC_M6192	UCS	K.2.1
Piani	James		DC_M6898	UCS	K.2.1
Piazza	Felice		DC_M5842	UCS	K.2.1
Picardy	Jonathan		DC_M3725	UCS	K.2.1
Pickell	Lindsay		DC_M6845	UCS	K.2.1
Pickett	Don		DC_M2158	UCS	K.2.1
Pickrell	Gayle		DC_E0391		K.2.2
Pickup	Del		DC_E0087		K.2.2
Piechuta	Sarah		DC_M4570	UCS	K.2.1
Piehl	Eric		DC_M2733	UCS	K.2.1
Pielaszckyk	Donna		DC_M5733	UCS	K.2.1
Pieper	John		DC_M4076	UCS	K.2.1
Pierce	Bob		DC_M0967	UCS	K.2.1
Pierce	Caitlin		DC_M3419	UCS	K.2.1
Pierce	Crystal		DC_M1539	UCS	K.2.1
Pierce	Karen		DC_M5301	UCS	K.2.1
Pierce	Merrill W.		DC_M0877	UCS	K.2.1
Pierpont	Leslie		DC_M7572	UCS	K.2.1
Pierquet	Kat		DC_M5080	UCS	K.2.1
Pierson	James A.		DC_M0567		K.2.1
Pierson	Lacey		DC_M3689	UCS	K.2.1
Pierson	Lacey		DC_M3695	UCS	K.2.1
Pietras	Ted		DC_M2318	UCS	K.2.1
Piett	Sharon		DC_M2577	UCS	K.2.1
Pigeon	Maura		DC_M3964	UCS	K.2.1
Pigeon	Sarah		DC_M1429	UCS	K.2.1
Pihl	Julie		DC_M2978	UCS	K.2.1
Pikus	Barbara		DC_E0283		K.3.2, K.3.3, K.3.11, K.3.12, K.3.13, K.3.15
Pilcher	Bonnie		DC_M5015	UCS	K.2.1
Pilcher	Bonnie		DC_M5016	UCS	K.2.1
Pilisuk	Mark		DC_E0015	Professor Univeristy of California Saybrook Graduate School	K.3.3, K.3.5, K.3.6, K.3.11, K.3.12
Pinkel	Georgia		DC_M7418	UCS	K.2.1
Pinkerton	Ann		DC_M1459	UCS	K.2.1
Pintavalle	Micheal		DC_M3058	UCS	K.2.1
Piper	Cynthia		DC_M2050	UCS	K.2.1
Pippin	Carol		DC_M3059	UCS	K.2.1
Piro	Peter		DC_M6337	UCS	K.2.1
Pirolo	Frank		DC_M4296	UCS	K.2.1
Pisano	Lisa		DC_M6073	UCS	K.2.1
Pisenti	Neal		DC_M3841	UCS	K.2.1
Pita	Adrianna		DC_M7820		K.2.1
Pitkin	Peter B		DC_M3066	UCS	K.2.1
Pittenger	Robert		DC_M4705	UCS	K.2.1
Pitz	Greg		DC_M1656	UCS	K.2.1
Pivonka	Jim		DC_M2985	UCS	K.2.1
Piwonka-Corle	Timothy		DC_M2310	UCS	K.2.1
Pizzini	Louis		DC_M7323	UCS	K.2.1
Pizzo	Julie		DC_M2260	UCS	K.2.1
Pla	Andy		DC_M5430	UCS	K.2.1
Plack	Bernice		DC_M7437	UCS	K.2.1

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Planisek	Amanda		DC_M1773	UCS	K.2.1
Platt	Paul		DC_M4651	UCS	K.2.1
Plesh	Dave	Pat Davis	DC_M5376	UCS	K.2.1
Plotnick	Steven		DC_M7504	UCS	K.2.1
Plotnik	Neal		DC_M5688	UCS	K.2.1
Plucinski	Katherine		DC_M2066	UCS	K.2.1
Plumley	Constance V.		DC_M1193	UCS	K.2.1
Plummer	Carrie		DC_M7559	UCS	K.2.1
Plummer	John		DC_M5784	UCS	K.2.1
Podesta	J.D.		DC_M4249	UCS	K.2.1
Podietz	David		DC_M2960	UCS	K.2.1
Pogue	William		DC_M0646		K.2.1
Pohs	Cecilia		DC_M2114	UCS	K.2.1
Polce	Rocco		DC_M6866	UCS	K.2.1
Polejes	Brian		DC_E0266		K.2.3
Polk	Alisa		DC_M0130		K.2.1
Polk	Janine		DC_M7517	UCS	K.2.1
Pollack	Sasha		DC_M7429	UCS	K.2.1
Pollak	Gisela		DC_M7489	UCS	K.2.1
Pollard	Bev		DC_M3867	UCS	K.2.1
Pollard	Eloise		DC_M0025		K.2.2
Pollock	Celest		DC_M4716	UCS	K.2.1
Pollock	Jeri		DC_M5624	UCS	K.2.1
Pollock	Leafy		DC_M2833	UCS	K.2.1
Pollock	Marina		DC_M6483	UCS	K.2.1
Polly	Jonathon		DC_M5478	UCS	K.2.1
Polokoff	Beverly		DC_M4133	UCS	K.2.1
Pomerantz	Fred		DC_M4212	UCS	K.2.1
Pomerantz	Gigi		DC_M5593	UCS	K.2.1
Pool	Elayne		DC_PHO0045		K.3.1, K.3.2, K.3.3, K.3.4, K.3.10, K.3.11, K.3.13, K.3.15, K.4
Pool	Elayne	Honolulu Friends (Quaker) Meeting	DC_PHW0011		K.2.3
Poole	Anne-Marie		DC_M3310	UCS	K.2.1
Poosakey	Poosakey		DC_M6400	UCS	K.2.1
Pope	Sarah		DC_M4718	UCS	K.2.1
Popodi	Ellen		DC_M1531	UCS	K.2.1
Popolizio	Carlo		DC_M7530	UCS	K.2.1
Popper	Serge		DC_M3967	UCS	K.2.1
Porter	Cheri		DC_M3004	UCS	K.2.1
Porter	David		DC_M5458	UCS	K.2.1
Porter	David		DC_M7544	UCS	K.2.1
Porter	Marian Jane		DC_M4322	UCS	K.2.1
Porter	Maya		DC_E0084		K.3.2, K.3.3, K.3.6, K.3.10, K.3.12, K.3.15
Portillo	Roni		DC_M0823	UCS	K.2.1
Poruks	Yasmin		DC_M0599		K.2.1
Posey	Amie		DC_M4540	UCS	K.2.1
Posner	David		DC_M5315	UCS	K.2.1
Potopowicz	Patrick		DC_M3740	UCS	K.2.1
Pototsky	Myrna		DC_M3802	UCS	K.2.1
Potter	Brandon		DC_M5907	UCS	K.2.1
Potter	Stephanie		DC_M3309	UCS	K.2.1
Potts	Tina M.		DC_M4949	UCS	K.2.1
Povec	Karen		DC_M5511	UCS	K.2.1
Powanda	Kim		DC_M3736	UCS	K.2.1
Powell	Diane		DC_M3383	UCS	K.2.1
Powell	Felix		DC_E0201		K.2.3

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Powell	John		DC_M3351	UCS	K.2.1
Powell	Kandis		DC_M1897	UCS	K.2.1
Powell	Ralph		DC_M2685	UCS	K.2.1
Power	Martin		DC_M4806	UCS	K.2.1
Powers	James		DC_M5595	UCS	K.2.1
Powers	Layne Edward		DC_M1195	UCS	K.2.1
Praigg	Eleanor		DC_M2933	UCS	K.2.1
Prather	Beth		DC_M2390	UCS	K.2.1
Pratt	Bryan		DC_M6421	UCS	K.2.1
Pratt	Chris		DC_M4926	UCS	K.2.1
Pratt	Don		DC_M2433	UCS	K.2.1
Pratt	L. Darlene		DC_M6202	UCS	K.2.1
Prazenka	S.M.		DC_M0649		K.2.1
Premlall	Anandi		DC_M5678	UCS	K.2.1
Prescott	Daniel		DC_M2149	UCS	K.2.1
Prescott	Stephen		DC_M4834	UCS	K.2.1
Presnell	Katy		DC_M4078	UCS	K.2.1
Press	Roland A.		DC_M0611		K.2.1
Press	Roland A.		DC_M3369	UCS	K.2.1
Prestwood	Carrie		DC_M0935	UCS	K.2.1
Prewitt	Isabel		DC_M2425	UCS	K.2.1
Price	Edwin		DC_M0079		K.2.1
Price	Maria Young		DC_M1222	UCS	K.2.1
Price	Susan		DC_M7597	UCS	K.2.1
Price	Terri		DC_M7813		K.2.3
Pridgeon	Carol		DC_M2266	UCS	K.2.1
Prigge	Diane		DC_M5632	UCS	K.2.1
Pringer	Christopher		DC_M1209	UCS	K.2.1
Pringle	Virginia		DC_M1337	UCS	K.2.1
Prins	Rose Marie		DC_M3354	UCS	K.2.1
Pritchard	Morgan		DC_M4380	UCS	K.2.1
Prochowski	Walter		DC_M2843	UCS	K.2.1
Proctor	Rebecca		DC_M2667	UCS	K.2.1
Proeger	Terry		DC_M4145	UCS	K.2.1
Progebin	Marshall		DC_M0164		K.2.1
Prokopow	Jean		DC_M6472	UCS	K.2.1
Pronio	Michaela		DC_M1083	UCS	K.2.1
Prosperie	Johnnie		DC_M7384	UCS	K.2.1
Prosser	James		DC_M5895	UCS	K.2.1
Prost	Carol		DC_M1444	UCS	K.2.1
Prostko	Linda		DC_M0420		K.2.1
Provenzano	James		DC_M1526	UCS	K.2.1
Pruden	Lynda		DC_M6883	UCS	K.2.1
Puca	Laurie		DC_M7044	UCS	K.2.1
Puchta	George		DC_M0866	UCS	K.2.1
Pudzianowski	Lydia		DC_M7307	UCS	K.2.1
Puett	James		DC_M2559	UCS	K.2.1
Puga	Ramon		DC_E0039		K.3.2, K.3.4, K.3.6, K.3.11, K.3.12, K.3.13
Pulling	Steven T.		DC_M0634		K.2.1
Pulvino	John		DC_M0927	UCS	K.2.1
Purchase	Daryl L.		DC_M0349		K.2.1
Purchase	Daryl L.		DC_M3542	UCS	K.2.1
Purchase	Daryl L.		DC_M7693		K.2.1
Purvis	Cheryl		DC_M1374	UCS	K.2.1
Pusel	Joyce L.		DC_M6601	UCS	K.2.1
Putnam	Jeff		DC_M6924	UCS	K.2.1
Putzel	Mary		DC_M1605	UCS	K.2.1
Putzi	Marie		DC_M4342	UCS	K.2.1

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Quammen	Parker		DC_M3067	UCS	K.2.1
Quart	Leonard		DC_M4030	UCS	K.2.1
Queen	Carol		DC_M1567	UCS	K.2.1
Quellas	Matthew		DC_M4627	UCS	K.2.1
Quereshi	Amna		DC_M1675	UCS	K.2.1
Quick	Heather		DC_M5926	UCS	K.2.1
Quick	Heather		DC_M6493	UCS	K.2.1
Quinlan	Alby		DC_M0107		K.2.1
Quinn	Caritas		DC_M5211	UCS	K.2.1
Quinn	James		DC_M4121	UCS	K.2.1
Quinn	James		DC_M7322	UCS	K.2.1
Quinn	Luther		DC_M1497	UCS	K.2.1
Quinn	Michael		DC_M0537		K.2.1
Quinn	Michael		DC_M3654	UCS	K.2.1
Quintana	Barbara		DC_M1739	UCS	K.2.1
Quintana	David M.		DC_M3810	UCS	K.2.1
Quirk	Dawn		DC_M4067	UCS	K.2.1
Raab	Art		DC_M3120	UCS	K.2.1
Raaste	Pentti		DC_M2644	UCS	K.2.1
Raber	Dima		DC_M4262	UCS	K.2.1
Rabin	Barry		DC_M3089	UCS	K.2.1
Rabiolo	James		DC_M2333	UCS	K.2.1
Race	Mary		DC_M4957	UCS	K.2.1
Racela	Jason		DC_M2176	UCS	K.2.1
Racela	Susan		DC_M1978	UCS	K.2.1
Raczkiewicz	Susier		DC_M5550	UCS	K.2.1
Radbil	Alexandra		DC_M3384	UCS	K.2.1
Rader	Doug		DC_M3767	UCS	K.2.1
Radford	Lemoine		DC_M2071	UCS	K.2.1
Radisic	Nikola		DC_M4321	UCS	K.2.1
Radzik	Karen		DC_M3881	UCS	K.2.1
Rae	Charlotte		DC_E0017		K.3.2, K.3.7, K.3.11, K.3.12
Rae	Robin		DC_M4452	UCS	K.2.1
Raghav	Shyla		DC_M1549	UCS	K.2.1
Ragle	Nancy		DC_M3959	UCS	K.2.1
Rahman	Karen		DC_M2544	UCS	K.2.1
Rain	Patricia		DC_M6923	UCS	K.2.1
Raine	Steven C.		DC_M0514		K.2.1
Raines	Mary Elizabeth		DC_M6794	UCS	K.2.1
Rainey	Dorli		DC_M6744	UCS	K.2.1
Rains	Gail		DC_M5250	UCS	K.2.1
Rains	Meg		DC_M5559	UCS	K.2.1
Rakoczy	Paul M.		DC_M4195	UCS	K.2.1
Ralabate	Teresa		DC_M1087	UCS	K.2.1
Ralph	Neil		DC_M5826	UCS	K.2.1
Rambaund	Rob		DC_M0505		K.2.1
Ramberg	David J		DC_M2340	UCS	K.2.1
Ramey	Kevin		DC_M2844	UCS	K.2.1
Ramirez	Marie T.		DC_M5260	UCS	K.2.1
Ramlow	Marguerite		DC_M7136	UCS	K.2.1
Ramos	Edna		DC_M3283	UCS	K.2.1
Ramp	Barbara		DC_M6414	UCS	K.2.1
Ramsey	Jeffery		DC_M2484	UCS	K.2.1
Ramstead	Julie		DC_M3418	UCS	K.2.1
Rand	Mary		DC_M4968	UCS	K.2.1
Randall	eliza		DC_M6284	UCS	K.2.1
Rando	Ernest		DC_M0148		K.2.1
Rando	Kim		DC_M7755		K.2.1
Ranford	Alan		DC_M3294	UCS	K.2.1

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Rankin	HL		DC_M3906	UCS	K.2.1
Ransom	G. Harry		DC_M6270	UCS	K.2.1
Ransome	Susan		DC_M6946	UCS	K.2.1
Rao	Dinesh		DC_M2567	UCS	K.2.1
Raphael	D. Donna		DC_M1048	UCS	K.2.1
Raphael	Ravid		DC_E0409		K.3.1, K.3.3, K.3.5, K.3.10, K.3.11, K.3.13
Rapport	Ari		DC_M5058	UCS	K.2.1
Rarick	Lucinda		DC_M0963	UCS	K.2.1
Rasmussen	Stephen		DC_M7564	UCS	K.2.1
Ratcliffe	John		DC_M3457	UCS	K.2.1
Ratley	Emily		DC_M2292	UCS	K.2.1
Rauch	Matt		DC_M6017	UCS	K.2.1
Raven	Jacqueline		DC_M3617	UCS	K.2.1
Ravey	Donald		DC_E0097		K.3.1, K.3.2, K.3.3, K.3.4, K.3.11, K.3.13, K.3.14
Rawlings	Joseph		DC_M2992	UCS	K.2.1
Rawlinson	Richard		DC_M5248	UCS	K.2.1
Ray	Gisela		DC_M0247		K.3.2, K.3.10, K.3.13, K.3.14
Ray	Gisela		DC_M2716	UCS	K.2.1
Ray	Richard		DC_M3539	UCS	K.2.1
Raymer	K.		DC_M3746	UCS	K.2.1
Raynis	ST		DC_M1621	UCS	K.2.1
Rea	Donald	Elizabeth Rea	DC_M0220		K.3.1, K.3.2, K.3.3, K.3.13
Rea	Kim		DC_M0233		K.3.2, K.3.10, K.3.14
Read	Seth		DC_M1112	UCS	K.2.1
Reader	Robert D.	Mary S. Reader	DC_M5207	UCS	K.2.1
Reagel	Peter		DC_M6900	UCS	K.2.1
Reams	Gail J.		DC_M1447	UCS	K.2.1
reaume	Greg		DC_M6608	UCS	K.2.1
Reaume	James		DC_M7371	UCS	K.2.1
Rebello	Leo		DC_E0198	World Constitution and Parliament Association (WCPA)	K.3.2, K.3.3, K.3.4, K.3.6, K.3.7, K.3.11, K.3.12, K.3.15, K.3.18
Redd	Sherry		DC_M0433		K.2.1
Redding	Sherley		DC_M5533	UCS	K.2.1
Redgate	Edward		DC_M2211	UCS	K.2.1
Redish	Maryellen		DC_M4393	UCS	K.2.1
Redmond	Molly		DC_M0542		K.2.1
Redoutey	Colleen		DC_M1533	UCS	K.2.1
Redwine	Rebecca		DC_M3741	UCS	K.2.1
Reece	Catherine		DC_M2680	UCS	K.2.1
Reece	Gregory A.		DC_M6689	UCS	K.2.1
Reece	Monique		DC_M1819	UCS	K.2.1
Reed	Andrew		DC_M0524		K.2.1
Reed	Casey		DC_M3797	UCS	K.2.1
Reed	Jacqueline		DC_M2299	UCS	K.2.1
Reed	James		DC_M6281	UCS	K.2.1
Reed	Lisa		DC_M1141	UCS	K.2.1
Reed	Patricia		DC_M5722	UCS	K.2.1
Reed	Phyllis		DC_M2411	UCS	K.2.1
Reed	S		DC_M0884	UCS	K.2.1
Reed	Shannon		DC_M0985	UCS	K.2.1
Reed	Thomas		DC_M0929	UCS	K.2.1
Reef	Jack		DC_M1688	UCS	K.2.1
Rees	Phyllis		DC_M4220	UCS	K.2.1
Reese	Carol		DC_M7828		K.2.3
Reeser	Cheryl		DC_M7675	UCS	K.2.1
Regan	Carol		DC_M2880	UCS	K.2.1

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Regan	Mary-Helen		DC_M2375	UCS	K.2.1
Regan	Monica		DC_M0593		K.2.1
Rehm	Rush		DC_M4699	UCS	K.2.1
Rehwinkel	Christine		DC_M6018	UCS	K.2.1
Reice	Kelly		DC_M5682	UCS	K.2.1
Reich	Helen		DC_M5225	UCS	K.2.1
Reichardt	Dorothy		DC_M3147	UCS	K.2.1
Reichenbach	Bob		DC_M7892		K.3.2, K.3.3
Reichert	Gregory		DC_M4986	UCS	K.2.1
Reichman	Christine		DC_PHO0040		K.3.1, K.3.3, K.3.7, K.3.11, K.3.13, K.3.15
Reid	Alison		DC_M5792	UCS	K.2.1
Reid	Christi		DC_P0010		K.3.9
Reid	Glen A.		DC_M0122		K.2.1
Reid	Kelly		DC_M0742		K.2.1
Reid	Leonard		DC_M0824	UCS	K.2.1
Reid	M.		DC_M4555	UCS	K.2.1
Reidinger	Melinda		DC_M1667	UCS	K.2.1
Reif	Frederick		DC_M2427	UCS	K.2.1
Reif	Patricia		DC_M7257	UCS	K.2.1
Reilly	Sheila		DC_M4606	UCS	K.2.1
Reimers	David		DC_M5917	UCS	K.2.1
Reindl	Leslie		DC_E0205		K.3.2, K.3.4, K.3.12
Reinhard	David		DC_M0558		K.2.1
Reis	Walter		DC_M1182	UCS	K.2.1
Reissen	Gail		DC_M5645	UCS	K.2.1
Reiter	Michael		DC_E0099		K.3.1, K.3.4, K.3.7, K.3.10, K.3.13, K.3.14
Rejman	Diane		DC_E0050		K.3.2, K.3.7, K.3.10, K.3.12
Relyea	Bruce		DC_M1301	UCS	K.2.1
Relyea	Tezel		DC_M6669	UCS	K.2.1
Remington	Margaret		DC_M0064		K.2.1
Remington	Margaret		DC_M3733	UCS	K.2.1
Rengers	Edward		DC_M6979	UCS	K.2.1
Renner	Robert		DC_M2646	UCS	K.2.1
Reno	Joanne		DC_M3258	UCS	K.2.1
Reppe	Peter		DC_M3161	UCS	K.2.1
Revuluri	Sendhil		DC_M1680	UCS	K.2.1
Reycraft	Astarte		DC_M0535		K.2.1
Reyes	Fran		DC_M6185	UCS	K.2.1
Reynolds	Patricia		DC_M2536	UCS	K.2.1
Reynolds	William		DC_M1766	UCS	K.2.1
Reynoldson	George		DC_M2603	UCS	K.2.1
Reynols	Jonelle		DC_M2525	UCS	K.2.1
Rhine	Pam		DC_M6427	UCS	K.2.1
Rhoads	Kirk		DC_M6548	UCS	K.2.1
Rhodes	Anne		DC_M5034	UCS	K.2.1
Rhodes	Thompson		DC_E0191		K.3.3, K.3.12, K.3.13
Rhodin	Micheal		DC_M2235	UCS	K.2.1
Rice	Jan	Lake Connolly	DC_M0172		K.2.1
Rice	Joan		DC_M5390	UCS	K.2.1
Rice	Thomas		DC_M6668	UCS	K.2.1
Ricevuto	Chuck		DC_M0674		K.2.1
Ricevuto	Chuck		DC_M3428	UCS	K.2.1
Rice-Williams	Lisa		DC_M0844	UCS	K.2.1
Rich	Dave		DC_E0275		K.3.14
Rich	David		DC_M7436	UCS	K.2.1
Rich	Nathan		DC_M1919	UCS	K.2.1
Rich	Winnie		DC_M4209	UCS	K.2.1

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Rich	Dave		DC_M7550	UCS	K.2.1
Richard	Louis		DC_M1365	UCS	K.2.1
Richard	N		DC_M2455	UCS	K.2.1
Richard	Christine		DC_M7541	UCS	K.2.1
Richardson	Don		DC_M0139		K.3.2, K.3.3, K.3.4, K.3.5, K.3.6, K.3.10, K.3.12
Richardson	Heather		DC_M0503		K.2.1
Richardson	J.		DC_M7377	UCS	K.2.1
Richardson	Linda		DC_M6828	UCS	K.2.1
Richardson	Marianna F.		DC_M3891	UCS	K.2.1
Richardson	Michael		DC_M1585	UCS	K.2.1
Richardson	Mike		DC_M0314		K.2.1
Richmond	Lonna		DC_M2099	UCS	K.2.1
Richmond	Lonna		DC_M2102	UCS	K.2.1
Richmond	Lonna		DC_M2103	UCS	K.2.1
Richmond	Susan		DC_M4693	UCS	K.2.1
Richter	Lane		DC_M6477	UCS	K.2.1
Rick	Carol		DC_E0061		K.3.1, K.3.5, K.3.7
Rick	Margie		DC_M3667	UCS	K.2.1
Rickard	Mary		DC_M2712	UCS	K.2.1
Ricker	Charlene		DC_E0217		K.2.2
Rickman	Dana		DC_M4844	UCS	K.2.1
Ricks	Linda		DC_M6205	UCS	K.2.1
Riddell	Colette		DC_M1494	UCS	K.2.1
Riddell	Colette		DC_M1495	UCS	K.2.1
Rider	Barbara		DC_M5292	UCS	K.2.1
Ridot	Faith		DC_M0527		K.2.1
Rieber	Emily		DC_M4578	UCS	K.2.1
Riecke	Hermann		DC_M4695	UCS	K.2.1
Riehart	Dale		DC_M2412	UCS	K.2.1
Riehl	Linda		DC_M5222	UCS	K.2.1
Riehle	Barry		DC_M7690		K.2.1
Rieken	Henry		DC_M6435	UCS	K.2.1
Riell	Dana		DC_M3618	UCS	K.2.1
Rigali	Susan		DC_M1888	UCS	K.2.1
Riggins	Patricia		DC_M7825		K.2.1
Riggs	Charles		DC_M3975	UCS	K.2.1
Riggs	Richard		DC_M4754	UCS	K.2.1
Riley	Barbara		DC_M1972	UCS	K.2.1
Riley	Benjamin		DC_M7704		K.3.4, K.3.11
Riley	Ray		DC_M1030	UCS	K.2.1
Rimbos	Peter		DC_M7737		K.3.1, K.3.2, K.3.7, K.3.10, K.3.11, K.3.13, K.3.14
Ringer	Ramona		DC_E0248		K.2.3
Rinzler	Deborah		DC_M3785	UCS	K.2.1
Ripple	Joan M.		DC_M1999	UCS	K.2.1
Risedorph	Jamie		DC_M4024	UCS	K.2.1
Riseley	Viv		DC_M7069	UCS	K.2.1
Rish	Shirley		DC_M6643	UCS	K.2.1
Ritchey	Melissa		DC_M1344	UCS	K.2.1
Ritchings	Anne		DC_M3386	UCS	K.2.1
Ritchison	Ric	Debbie Ritchison	DC_M3444	UCS	K.2.1
Rittenhouse	Calvin		DC_M3536	UCS	K.2.1
Ritter	Alissa		DC_M0816	UCS	K.2.1
Ritter	Sam		DC_M6552	UCS	K.2.1
Rittle	Lori		DC_M7717		K.2.1
Ritz	John		DC_E0417		K.3.2, K.3.3, K.3.7, K.3.13
Ritz	John		DC_E0419		K.3.2, K.3.3, K.3.7, K.3.13
Ritz	John		DC_E0422		K.3.2, K.3.3, K.3.7, K.3.13

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Ritzman	Michael	Genevieve	DC_M0258		K.3.7
Rivera	Carmen G.		DC_M3659	UCS	K.2.1
Rives	Barbara		DC_M5321	UCS	K.2.1
Rivin	Jean		DC_M4000	UCS	K.2.1
Roark	Juanita		DC_M4919	UCS	K.2.1
Roba	Anthony		DC_M1464	UCS	K.2.1
Robbins	Brett		DC_M1577	UCS	K.2.1
Robbins	Jan		DC_M5892	UCS	K.2.1
Robbins	Kandi		DC_M7357	UCS	K.2.1
Robbins	Richard		DC_M1097	UCS	K.2.1
Roben	Terri		DC_M6952	UCS	K.2.1
Roberti	Billii		DC_M2966	UCS	K.2.1
Roberts	Courtney		DC_M0574		K.2.1
Roberts	F.J.		DC_M0828	UCS	K.2.1
Roberts	James		DC_M0924	UCS	K.2.1
Roberts	James		DC_M7806		K.3.4, K.3.5, K.3.7, K.3.10, K.3.11, K.3.13, K.3.15, K.4
Roberts	Norman		DC_M2570	UCS	K.2.1
Roberts	Rebekah		DC_M1597	UCS	K.2.1
Roberts	Seth G.		DC_M1902	UCS	K.2.1
Robertson	Cornelia		DC_M2809	UCS	K.2.1
Robertson	James		DC_E0315		K.3.5, K.3.6, K.3.12, K.3.15
Robertson	Jenna		DC_M4154	UCS	K.2.1
Robertson	Katherine		DC_M2652	UCS	K.2.1
Robertson	Merilie		DC_M4259	UCS	K.2.1
Robinson	Barbara		DC_M3750	UCS	K.2.1
Robinson	Crystal		DC_M4144	UCS	K.2.1
Robinson	David		DC_M7609	UCS	K.2.1
Robinson	George		DC_M6824	UCS	K.2.1
Robinson	Jacqueline		DC_M2789	UCS	K.2.1
Robinson	Jennifer		DC_M7254	UCS	K.2.1
Robinson	Joan		DC_M5499	UCS	K.2.1
Robinson	Marcia		DC_M5677	UCS	K.2.1
Robinson	Maxine		DC_M4050	UCS	K.2.1
Robinson	Richard		DC_M1930	UCS	K.2.1
Robinson	Saliane		DC_M2483	UCS	K.2.1
Robinson	Susan		DC_M4595	UCS	K.2.1
Robinson	Tammy		DC_M6412	UCS	K.2.1
Robintree	Robin		DC_M6253	UCS	K.2.1
Robles	Rosalie		DC_M4119	UCS	K.2.1
Robson	Marilyn		DC_M2311	UCS	K.2.1
Rocchio	Gina		DC_M3560	UCS	K.2.1
Rocheleau	Jessica		DC_M1482	UCS	K.2.1
Rochlin	Robert		DC_M7056	UCS	K.2.1
Rockefeller	Edward		DC_M2638	UCS	K.2.1
Rockhill	Lois		DC_E0104	Second Harvest Food Bank	K.3.1
Rockhold	John		DC_M7855		K.2.3
Rocks	Sue		DC_M6423	UCS	K.2.1
Rockwell	Linda		DC_M4679	UCS	K.2.1
Rodack	Soretta		DC_M2258	UCS	K.2.1
Roddy	Jane		DC_M4829	UCS	K.2.1
Rode	Forrest		DC_M3114	UCS	K.2.1
Rode	Katharine		DC_M0720		K.2.1
Rode	Katharine		DC_M6305	UCS	K.2.1
Roden	Tessa		DC_M6170	UCS	K.2.1
Rodgers	Julie		DC_M6449	UCS	K.2.1
Rodgers	Patricia		DC_M7326	UCS	K.2.1
Rodine	Jean		DC_M0355		K.2.1

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Rich	Dave		DC_M7550	UCS	K.2.1
Richard	Louis		DC_M1365	UCS	K.2.1
Richard	N		DC_M2455	UCS	K.2.1
Richard	Christine		DC_M7541	UCS	K.2.1
Richardson	Don		DC_M0139		K.3.2, K.3.3, K.3.4, K.3.5, K.3.6, K.3.10, K.3.12
Richardson	Heather		DC_M0503		K.2.1
Richardson	J.		DC_M7377	UCS	K.2.1
Richardson	Linda		DC_M6828	UCS	K.2.1
Richardson	Marianna F.		DC_M3891	UCS	K.2.1
Richardson	Michael		DC_M1585	UCS	K.2.1
Richardson	Mike		DC_M0314		K.2.1
Richmond	Lonna		DC_M2099	UCS	K.2.1
Richmond	Lonna		DC_M2102	UCS	K.2.1
Richmond	Lonna		DC_M2103	UCS	K.2.1
Richmond	Susan		DC_M4693	UCS	K.2.1
Richter	Lane		DC_M6477	UCS	K.2.1
Rick	Carol		DC_E0061		K.3.1, K.3.5, K.3.7
Rick	Margie		DC_M3667	UCS	K.2.1
Rickard	Mary		DC_M2712	UCS	K.2.1
Ricker	Charlene		DC_E0217		K.2.2
Rickman	Dana		DC_M4844	UCS	K.2.1
Ricks	Linda		DC_M6205	UCS	K.2.1
Riddell	Colette		DC_M1494	UCS	K.2.1
Riddell	Colette		DC_M1495	UCS	K.2.1
Rider	Barbara		DC_M5292	UCS	K.2.1
Ridot	Faith		DC_M0527		K.2.1
Rieber	Emily		DC_M4578	UCS	K.2.1
Riecke	Hermann		DC_M4695	UCS	K.2.1
Riehart	Dale		DC_M2412	UCS	K.2.1
Riehl	Linda		DC_M5222	UCS	K.2.1
Riehle	Barry		DC_M7690		K.2.1
Rieken	Henry		DC_M6435	UCS	K.2.1
Riell	Dana		DC_M3618	UCS	K.2.1
Rigali	Susan		DC_M1888	UCS	K.2.1
Riggins	Patricia		DC_M7825		K.2.1
Riggs	Charles		DC_M3975	UCS	K.2.1
Riggs	Richard		DC_M4754	UCS	K.2.1
Riley	Barbara		DC_M1972	UCS	K.2.1
Riley	Benjamin		DC_M7704		K.3.4, K.3.11
Riley	Ray		DC_M1030	UCS	K.2.1
Rimbos	Peter		DC_M7737		K.3.1, K.3.2, K.3.7, K.3.10, K.3.11, K.3.13, K.3.14
Ringer	Ramona		DC_E0248		K.2.3
Rinzler	Deborah		DC_M3785	UCS	K.2.1
Ripple	Joan M.		DC_M1999	UCS	K.2.1
Risedorph	Jamie		DC_M4024	UCS	K.2.1
Riseley	Viv		DC_M7069	UCS	K.2.1
Rish	Shirley		DC_M6643	UCS	K.2.1
Ritchey	Melissa		DC_M1344	UCS	K.2.1
Ritchings	Anne		DC_M3386	UCS	K.2.1
Ritchison	Ric	Debbie Ritchison	DC_M3444	UCS	K.2.1
Rittenhouse	Calvin		DC_M3536	UCS	K.2.1
Ritter	Alissa		DC_M0816	UCS	K.2.1
Ritter	Sam		DC_M6552	UCS	K.2.1
Rittle	Lori		DC_M7717		K.2.1
Ritz	John		DC_E0417		K.3.2, K.3.3, K.3.7, K.3.13
Ritz	John		DC_E0419		K.3.2, K.3.3, K.3.7, K.3.13
Ritz	John		DC_E0422		K.3.2, K.3.3, K.3.7, K.3.13

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Rosenfield	Nancy		DC_M3172	UCS	K.2.1
Rosenlicht-Zingarelli	Carla		DC_M2725	UCS	K.2.1
Rosenow	Wayne		DC_M3893	UCS	K.2.1
Rosenstein	Robert		DC_M1858	UCS	K.2.1
Rosenstein	Robert		DC_M1859	UCS	K.2.1
Rosenthal	Ann		DC_M6166	UCS	K.2.1
Rosenthal	Marvin		DC_M4308	UCS	K.2.1
Rosenzweig	Aline		DC_M4355	UCS	K.2.1
Rosetti	Leana		DC_M6543	UCS	K.2.1
Rosher	Ellen		DC_M1881	UCS	K.2.1
Roska	Sue		DC_M6441	UCS	K.2.1
Ross	Aimee		DC_M0893	UCS	K.2.1
Ross	Andrea		DC_M0315		K.2.1
Ross	L. Marie		DC_M7627	UCS	K.2.1
Ross	Mary		DC_M0277		K.3.14
Ross	Michelle		DC_M4474	UCS	K.2.1
Ross	Pam		DC_M2177	UCS	K.2.1
Ross	Robert		DC_E0068		K.3.2, K.3.4, K.3.11, K.3.12, K.3.13, K.3.15
Ross	Susan		DC_M7097	UCS	K.2.1
Ross	Sylvia		DC_M5948	UCS	K.2.1
Rossetto	Kate		DC_M3734	UCS	K.2.1
Rossini	Giovanni		DC_M5429	UCS	K.2.1
Rossiter	Kel		DC_E0246		K.3.2, K.3.11, K.3.12
Rossman	Norman		DC_M6911	UCS	K.2.1
Roth	Heather		DC_M3726	UCS	K.2.1
Roth	Kurt		DC_M4248	UCS	K.2.1
Roth	Peter		DC_M5687	UCS	K.2.1
Rothermund	Jodi		DC_M1960	UCS	K.2.1
Rotholz	Abigail		DC_M4743	UCS	K.2.1
Rothwell	Shelley		DC_M3124	UCS	K.2.1
Rough	Anna		DC_M2136	UCS	K.2.1
Roundtree	Marthea		DC_F0003	United States Environmental Protection Agency	K.5
Rouse	George		DC_M4069	UCS	K.2.1
Rousu	Dwight		DC_E0030		K.3.2, K.3.3, K.3.4, K.3.6, K.3.7, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Row	Donna		DC_M6282	UCS	K.2.1
Rowe	Jeff		DC_M1553	UCS	K.2.1
Rowland	Liz		DC_M6505	UCS	K.2.1
Rowland	Theodore		DC_M5073	UCS	K.2.1
Roy	Jean		DC_M6714	UCS	K.2.1
Royack	Walter		DC_M2067	UCS	K.2.1
Royall	Chrys		DC_M4622	UCS	K.2.1
Roylance	Stephen		DC_M0933	UCS	K.2.1
Rozella	Dona		DC_M3597	UCS	K.2.1
Rubbert	Dawn		DC_E0252		K.2.2
Rubin	Leonard		DC_M4233	UCS	K.2.1
Rublev	E.J.		DC_M7161	UCS	K.2.1
Ruch	Aixa		DC_M1496	UCS	K.2.1
Ruch	Dave		DC_M1490	UCS	K.2.1
Ruch	Elizabeth		DC_M1498	UCS	K.2.1
Ruch	Lisette		DC_M1613	UCS	K.2.1
Ruch	Lisette		DC_M6544	UCS	K.2.1
Ruch II	David		DC_M1616	UCS	K.2.1
Ruckdeschel	Jenny		DC_M4913	UCS	K.2.1

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Rucker	Delicia		DC_M2047	UCS	K.2.1
Rudolph	Chari		DC_M7881		K.2.1
Rues	Nathan		DC_M4340	UCS	K.2.1
Ruff	Nicole		DC_M6126	UCS	K.2.1
Rugh	Dave		DC_M6809	UCS	K.2.1
Rugh	Ruthe		DC_M4605	UCS	K.2.1
Rugh	Ruthe		DC_M7496	UCS	K.2.1
Rugh	Ruthe		DC_M7501	UCS	K.2.1
Rugh	Ruthe		DC_M7526	UCS	K.2.1
Rui-z Castillo	Norma Alejandra		DC_M2490	UCS	K.2.1
Rule	Juliann		DC_M2374	UCS	K.2.1
Rumbaugh	Jane		DC_M0607		K.2.1
Rumberger	Sharon		DC_M6397	UCS	K.2.1
Runkle	Tori		DC_M2565	UCS	K.2.1
Ruopp	Kathy		DC_M7921		K.2.3
Ruppel	Elisabeth		DC_M2087	UCS	K.2.1
Ruscoe	Sandra		DC_M1828	UCS	K.2.1
Rush	Barbara		DC_M7223	UCS	K.2.1
Rusk	Steve		DC_M0726		K.2.1
Russell	Claire H.		DC_M7101	UCS	K.2.1
Russell	Coral		DC_M4055	UCS	K.2.1
Russell	Dwight		DC_M7832		K.2.1
Russell	John		DC_M1320	UCS	K.2.1
Russell	Maureen		DC_M4251	UCS	K.2.1
Russell	Sandra		DC_M0953	UCS	K.2.1
Russini	Elizabeth		DC_M4796	UCS	K.2.1
Russo	Cheryl		DC_M3682	UCS	K.2.1
Russo	Rita		DC_M1806	UCS	K.2.1
Rusten	June		DC_M2710	UCS	K.2.1
Ruta	George		DC_M5612	UCS	K.2.1
Ruth	Phyllis		DC_M1557	UCS	K.2.1
Rutheiser	Michele		DC_M0597		K.2.1
Ryan	Alice May		DC_E0194		K.2.4
Ryan	Mari		DC_E0292		K.3.2, K.3.12
Ryan	Pamela		DC_M1662	UCS	K.2.1
Ryan	Patricia		DC_M4305	UCS	K.2.1
Rydant	Margaret		DC_M7016	UCS	K.2.1
Ryder	William		DC_M0851	UCS	K.2.1
Rymer	Craig		DC_M5790	UCS	K.2.1
S	Alexandra		DC_M2800	UCS	K.2.1
S	Simiya		DC_M5372	UCS	K.2.1
S	Stephanie		DC_M6864	UCS	K.2.1
Sabar	Stephanie		DC_M5723	UCS	K.2.1
Sabers	Kenneth		DC_M5691	UCS	K.2.1
Sabinson	Mara		DC_M0336		K.2.1
Sack	Jason		DC_M5488	UCS	K.2.1
Sadanand	Ashwinee		DC_M0746		K.2.1
Sadowski	Joan		DC_M1735	UCS	K.2.1
Sadowsky	Laura		DC_M6672	UCS	K.2.1
Saeger	Jeff		DC_M7858		K.2.1
Safran	Marcia		DC_M2668	UCS	K.2.1
Safran	Marcia		DC_M2669	UCS	K.2.1
Sagan	Sharon		DC_M4654	UCS	K.2.1
Sage	Joan		DC_M1256	UCS	K.2.1
Sage	Joan		DC_M5510	UCS	K.2.1
Sagen	Jacqueline		DC_M3403	UCS	K.2.1
Sager	Robert		DC_M3441	UCS	K.2.1
Sager	Tom		DC_M5679	UCS	K.2.1

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Sahhar	Dianna		DC_M5915	UCS	K.2.1
Sahlberg	Gabriella		DC_M1572	UCS	K.2.1
Saichek	Dianne		DC_M7324	UCS	K.2.1
Said	Peter		DC_M2058	UCS	K.2.1
Saidi	Jasmin		DC_M0417		K.2.1
Sailer	Randy		DC_M3610	UCS	K.2.1
Sakaguchi	Christine		DC_M7852		K.2.1
Sakun	Nina		DC_M7107	UCS	K.2.1
Sala	Nadia		DC_M4563	UCS	K.2.1
Salader	Roger		DC_M4029	UCS	K.2.1
Salas	Carol		DC_M6641	UCS	K.2.1
Salgado	Diego		DC_M4893	UCS	K.2.1
Salmestrelli	Jennifer		DC_M1669	UCS	K.2.1
Salmon	Herb		DC_M4917	UCS	K.2.1
Salmon	Kate		DC_M6269	UCS	K.2.1
Salotti	Susan E		DC_M7738		K.2.1
Salpeter	Ed		DC_E0245		K.3.1, K.3.2, K.3.4, K.3.11, K.3.14
Salpeter	Edwin		DC_M0001		K.3.4, K.3.7, K.3.12, K.3.14
Salpeter	Edwin		DC_M4877	UCS	K.2.1
Salvaggio	John		DC_M0709		K.2.1
Salvaggio	John		DC_M3453	UCS	K.2.1
Salvail	Michele		DC_M2771	UCS	K.2.1
Salzman	Judith		DC_E0178		K.2.2
Samberg	Helen		DC_M0019		K.2.2
Samelson	Audrey		DC_M4265	UCS	K.2.1
Sammons	Susanna		DC_M2225	UCS	K.2.1
Samples	Linda		DC_M7442	UCS	K.2.1
Samson	Victoria		DC_E0401	Center for Defense Information	K.4
Samson	Victoria		DC_PHO0001	Center for Defense Information	K.3.2, K.3.3, K.3.10, K.3.11, K.3.12, K.3.13, K.3.14, K.3.15, K.4
Samson	Victoria		DC_PHW0002	Center for Defense Information	K.3.12, K.3.15, K.4
Samuels	Janet		DC_M6007	UCS	K.2.1
Samuels	Joyce		DC_M3152	UCS	K.2.1
Samuels	William		DC_M1065	UCS	K.2.1
Samuelson	Barbara A		DC_M3019	UCS	K.2.1
San Filippo	Michael	Catherine San Filippo	DC_M0290		K.3.14
Sanchez	Alvaro		DC_M4779	UCS	K.2.1
Sanchez	Gabriele		DC_M4588	UCS	K.2.1
Sanchez	Hector		DC_M2683	UCS	K.2.1
Sanchez	Janette		DC_M3538	UCS	K.2.1
Sandall	Hilary		DC_M7210	UCS	K.2.1
Sandefur	Karen		DC_M2563	UCS	K.2.1
Sanders	Gary		DC_M0388		K.2.1
Sanders	Joanna		DC_M4411	UCS	K.2.1
Sanders	Ralph W.		DC_M1660	UCS	K.2.1
Sanders	Richard		DC_M3008	UCS	K.2.1
Sanders	Steve		DC_M7467	UCS	K.2.1
Sanders	Susan		DC_M5252	UCS	K.2.1
Sandford	Sophia Von		DC_M3684	UCS	K.2.1
Sandine	Al		DC_M0160		K.3.2, K.3.3, K.3.7, K.3.10, K.3.12, K.3.13
Sandler	Noah Doane		DC_M4219	UCS	K.2.1
Sandoval	Ani		DC_M1830	UCS	K.2.1
Sands	Kris		DC_M4008	UCS	K.2.1
Sant	Judyth		DC_M2615	UCS	K.2.1

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Sant	Judyth and Barbara		DC_M2616	UCS	K.2.1
Santana	Jose M Olmos		DC_M0577		K.2.1
Santana	Jose M Olmos		DC_M0692		K.2.1
Santana	Jose M Olmos		DC_M2977	UCS	K.2.1
Santana	Kathryn		DC_M4558	UCS	K.2.1
Santangelo	Matthew F.		DC_M6749	UCS	K.2.1
Santerre	Roger		DC_M0665		K.2.1
Santerre	Roger		DC_M4134	UCS	K.2.1
Santos	Christel		DC_M0351		K.2.1
Santowski	Celia		DC_M6326	UCS	K.2.1
Santoyo	Marlene		DC_M7483	UCS	K.2.1
Santulli	Carrie		DC_M6542	UCS	K.2.1
Sapiro	Mark		DC_M3140	UCS	K.2.1
Sappenfield	Patricia		DC_M2522	UCS	K.2.1
Sargent	Lloyd		DC_M6390	UCS	K.2.1
Sarinelli	Lisa		DC_M2732	UCS	K.2.1
Sariol	Teresa		DC_M7297	UCS	K.2.1
Sarja	Jennifer		DC_M6745	UCS	K.2.1
Sarr	Bob		DC_M5421	UCS	K.2.1
Sarrett	Ellen		DC_M7204	UCS	K.2.1
Sartini	Emily		DC_M6537	UCS	K.2.1
Sasser	Kristin		DC_M2426	UCS	K.2.1
Sauerberg-Amland	K. Kay		DC_M7186	UCS	K.2.1
Saum	George		DC_M4831	UCS	K.2.1
Saus	Steven		DC_M5094	UCS	K.2.1
Sausser	Chris		DC_M6189	UCS	K.2.1
Savage	Denise		DC_M0494		K.2.1
Savage	Matt		DC_M0700		K.2.1
Saveage	John	Patricia Savage	DC_M7798		K.2.1
Savino	Annette		DC_M2301	UCS	K.2.1
Savion	Susan		DC_M4021	UCS	K.2.1
Sawdon	Rosemarie		DC_M5350	UCS	K.2.1
Sawdon	Rosemarie		DC_M6048	UCS	K.2.1
Sawyer	Christy		DC_M4664	UCS	K.2.1
Sawyer	Fannette		DC_E0110		K.3.14
Saxe	Dorothy		DC_M5716	UCS	K.2.1
Sayer	Marjorie		DC_M3027	UCS	K.2.1
Sayers	Rick		DC_M7445	UCS	K.2.1
Saylan	Charles		DC_M7619	UCS	K.2.1
Sayre	Jean		DC_M2161	UCS	K.2.1
Sbrissa	Joellen		DC_M2661	UCS	K.2.1
Scadidi	Frances		DC_M0087		K.3.2, K.3.3, K.3.4, K.3.7, K.3.10, K.3.12
Scalise	Nancy		DC_M4872	UCS	K.2.1
Scallen	Janet		DC_E0393		K.3.2, K.3.3, K.3.7, K.3.12, K.3.15
Scamahorn	Mark		DC_M7317	UCS	K.2.1
Scanlon	Sean		DC_M7452	UCS	K.2.1
Scarl	Daniel		DC_M7842		K.3.4, K.3.7, K.3.11, K.3.13
Scarlata	Angela		DC_M6301	UCS	K.2.1
Scarlott	Charles		DC_M1896	UCS	K.2.1
Scarpone	Tom		DC_M1263	UCS	K.2.1
Schaad	James		DC_M0354		K.2.1
Schabitzer	Diane		DC_M6746	UCS	K.2.1
Schabitzer	Diane		DC_M7481	UCS	K.2.1
Schaefer	Dolores		DC_M3940	UCS	K.2.1
Schaefer	Dolores		DC_M6394	UCS	K.2.1
Schafer	Ann		DC_E0176		K.2.2

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Schafer	Ann		DC_M4476	UCS	K.2.1
Schaff	Sarah		DC_M4227	UCS	K.2.1
Schagrin	Morton L.		DC_M0838	UCS	K.2.1
Scharlack	Meyer		DC_M4554	UCS	K.2.1
Schatz	Bernie		DC_M3786	UCS	K.2.1
Schau	C		DC_M2855	UCS	K.2.1
Schauffler	Ann		DC_M5808	UCS	K.2.1
Scheele	Robert B.		DC_M6718	UCS	K.2.1
Scheiferstein	Jeanne		DC_M0289		K.2.1
Scheiner	Ellen		DC_M6616	UCS	K.2.1
Schepers	Marlyn		DC_M2223	UCS	K.2.1
Scheyd	Suzanne		DC_M4247	UCS	K.2.1
Scheyer	Marguerite		DC_M4157	UCS	K.2.1
Schick	Katherine		DC_M4425	UCS	K.2.1
Schieffer	Jennifer		DC_M6168	UCS	K.2.1
Schier	Will		DC_M4159	UCS	K.2.1
Schiller	Raymond		DC_M6650	UCS	K.2.1
Schipper	Peter		DC_M5705	UCS	K.2.1
Schivera	Diane		DC_M7286	UCS	K.2.1
Schlacter	Judith		DC_M7336	UCS	K.2.1
Schlagal	Robert		DC_M1770	UCS	K.2.1
Schlageter	Martin		DC_M2727	UCS	K.2.1
Schleidt	Monika		DC_E0046		K.3.2, K.3.3, K.3.7, K.3.11, K.3.12
Schleupner	Mark		DC_M3664	UCS	K.2.1
Schloessinger	Kathleen		DC_M7070	UCS	K.2.1
Schlosberg	Lester		DC_M7227	UCS	K.2.1
Schloss	Richard		DC_M3855	UCS	K.2.1
Schlosser	Jenna		DC_M6711	UCS	K.2.1
Schmid	Diane		DC_M3552	UCS	K.2.1
Schmid	George		DC_M1339	UCS	K.2.1
Schmidt	Caroline		DC_PHO0035		K.3.18
Schmidt	Ellen	Oskar Schmidt	DC_E0203		K.2.2
Schmidt	Gary		DC_M5653	UCS	K.2.1
Schmidt	Misti		DC_M7015	UCS	K.2.1
Schmidt	Sara		DC_M7412	UCS	K.2.1
Schmidt	William		DC_M7714		K.2.1
Schmitt	Ariel		DC_M2182	UCS	K.2.1
Schmitt	Joan		DC_M5516	UCS	K.2.1
Schmitt	Johanna		DC_M6451	UCS	K.2.1
Schmitt	Richard	Kathy Schmitt	DC_M6491	UCS	K.2.1
Schmitt	Robert J.		DC_M5294	UCS	K.2.1
Schmitthenner	Christine		DC_M4412	UCS	K.2.1
Schmitz	Gladys		DC_E0265		K.2.2
Schmitz	Patrick		DC_M0902	UCS	K.2.1
Schmitz	Ruth		DC_M5483	UCS	K.2.1
Schmotzer	Michael		DC_M0123		K.3.10, K.3.14
Schmotzer	Michael		DC_M0609		K.2.1
Schmultzer	Joe		DC_M5795	UCS	K.2.1
Schnaars	Michael		DC_M1283	UCS	K.2.1
Schnabel	Erik		DC_M5941	UCS	K.2.1
Schneider	Pauline		DC_M5076	UCS	K.2.1
Schnidler	Mark		DC_M5374	UCS	K.2.1
Schochet	Joy		DC_M5136	UCS	K.2.1
Schochet	Joy		DC_M6896	UCS	K.2.1
Schoder-Ehri	Ruthe		DC_M0874	UCS	K.2.1
Schoeler	Mikel		DC_M0080		K.2.1
Schoen	Tim		DC_M2851	UCS	K.2.1
Schoenacher	Naren		DC_M2418	UCS	K.2.1

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Schoene	Andrew		DC_M5106	UCS	K.2.1
Schoene	Clare		DC_M5857	UCS	K.2.1
Schoenthal	Nathan		DC_M4680	UCS	K.2.1
Schoenweiss	Paul		DC_M4102	UCS	K.2.1
Schoettler	Joanna		DC_M0564		K.2.1
Scholtes	Nick		DC_M0550		K.2.1
Schoppert	Amy King		DC_M4377	UCS	K.2.1
Schosser	Claire		DC_M7882		K.2.1
Schowalter	David		DC_M2197	UCS	K.2.1
Schrader	Kimberly		DC_M0566		K.2.1
Schrader	Susan		DC_M4981	UCS	K.2.1
Schramm	Bea		DC_M3010	UCS	K.2.1
Schramm	Peggy		DC_M1534	UCS	K.2.1
Schreffler	Lisa		DC_M5371	UCS	K.2.1
Schregel	Keri		DC_M0578		K.2.1
Schreiber	Pat		DC_M7147	UCS	K.2.1
Schreiber	Ramona		DC_E0403	NOAA	K.5
Schriner	Macie		DC_M7051	UCS	K.2.1
Schroeder	Bonnie		DC_M6513	UCS	K.2.1
Schroeder	Florence		DC_M0658		K.2.1
Schroeder	Joy		DC_M7733		K.2.1
Schroeder	Pablo		DC_M3203	UCS	K.2.1
Schubert	Gabriele		DC_M7807		K.2.1
Schuetz	Bettina		DC_M0992	UCS	K.2.1
Schulman	Edwina		DC_M6456	UCS	K.2.1
Schulof	Bob		DC_M5347	UCS	K.2.1
Schulte	Eileen		DC_M6268	UCS	K.2.1
Schulte	Michael		DC_M1342	UCS	K.2.1
Schultz	Claire		DC_M4290	UCS	K.2.1
Schultz	Judith		DC_M3196	UCS	K.2.1
Schultz	Richard		DC_E0074	Professor Division os Biochemistry Stritch School of Mdeicine Loyola University	K.3.2, K.3.10, K.3.11, K.3.13
Schulz	Jim		DC_M4075	UCS	K.2.1
Schulze	Karen		DC_M5525	UCS	K.2.1
Schumacher	Carl A		DC_M3052	UCS	K.2.1
Schumacher	Joan	David Friedman	DC_M0131		K.2.1
Schuman	James		DC_M1458	UCS	K.2.1
Schut	Dini		DC_M1517	UCS	K.2.1
Schutzius	Robert		DC_E0330		K.2.2
Schuurman	Gregor		DC_M6843	UCS	K.2.1
Schwartz	David		DC_M3037	UCS	K.2.1
Schwartz	Elaine		DC_M2969	UCS	K.2.1
Schwartz	Ellen		DC_PHO0019	Women's International League for Peace and Freedom, United States Section	K.3.1, K.3.4, K.3.5, K.3.10, K.3.11, K.3.15, K.4
Schwartz	Jami		DC_M3036	UCS	K.2.1
Schwartz	Kaye		DC_M5232	UCS	K.2.1
Schwartz	Liz		DC_M3687	UCS	K.2.1
Schwartz	Marie		DC_M1076	UCS	K.2.1
Schwartz	Nancy		DC_M0320		K.2.1
Schwartz	Norman		DC_M0569		K.2.1
Schwartz	Norman		DC_M0703		K.2.1
Schwartz	Renee		DC_M7356	UCS	K.2.1
Schwartz	Sally		DC_M0976	UCS	K.2.1
Schwartz	Sally		DC_M5274	UCS	K.2.1

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Schwartz	Steven		DC_M0184		K.2.1
Schwartz	Cindy		DC_M6361	UCS	K.2.1
Schwartzman	Maia		DC_M4975	UCS	K.2.1
Schweibish	Jean		DC_M4291	UCS	K.2.1
Schweitzer	John P.		DC_M0813	UCS	K.2.1
Schwering	Catherine		DC_M1187	UCS	K.2.1
Schwick	Keplin		DC_M5944	UCS	K.2.1
Schwytzer	John		DC_M6429	UCS	K.2.1
Scianna	Paolo		DC_M3281	UCS	K.2.1
Scire	Dawn		DC_M7652	UCS	K.2.1
Scivoletti	Michael		DC_M0842	UCS	K.2.1
Scott	Alan		DC_M1419	UCS	K.2.1
Scott	Anwyl		DC_M5459	UCS	K.2.1
Scott	Dorinda		DC_M7176	UCS	K.2.1
Scott	John Craig		DC_M1158	UCS	K.2.1
Scott	John P.		DC_M5356	UCS	K.2.1
Scott	Kathryn		DC_M4266	UCS	K.2.1
Scott	Robert E.		DC_M0207	member UCS	K.3.2, K.3.10, K.3.14
Scott	Tracy		DC_M6501	UCS	K.2.1
Scotton	Bruce		DC_M2150	UCS	K.2.1
Scuder	Amanda		DC_M3928	UCS	K.2.1
Scully	Helene		DC_M3531	UCS	K.2.1
Scwartz	Nancy		DC_M3129	UCS	K.2.1
Seabold	Danielle		DC_M6372	UCS	K.2.1
Seabrook	Kathy		DC_M3366	UCS	K.2.1
Seals	Wayne		DC_M1929	UCS	K.2.1
Sealy	Ramsey L		DC_M3293	UCS	K.2.1
Searain	Brenan		DC_M5158	UCS	K.2.1
Searfos	Polly		DC_M4285	UCS	K.2.1
Sebesta	Carla		DC_M2028	UCS	K.2.1
Seeley	Laurel		DC_M5127	UCS	K.2.1
Seeley	Lynda		DC_M5762	UCS	K.2.1
Seeley	Treacy		DC_M1541	UCS	K.2.1
Segal	Evalyn		DC_M4649	UCS	K.2.1
Segal	Jeffrey		DC_M4643	UCS	K.2.1
Segall-Anable	Linda		DC_M4485	UCS	K.2.1
Segar	James		DC_M4772	UCS	K.2.1
Segreto	Mary		DC_M3234	UCS	K.2.1
Seidel	Joan Wade		DC_M0473		K.2.1
Seidel	Peter		DC_M2645	UCS	K.2.1
Seifert	Richard		DC_M3579	UCS	K.2.1
Seigal	Nancy		DC_M0637		K.2.1
Seigal	Nancy		DC_M1122	UCS	K.2.1
Seigal	Nancy		DC_M1995	UCS	K.2.1
Seitzer	David		DC_M1191	UCS	K.2.1
Sekhon	Kanwaldeep K		DC_M2958	UCS	K.2.1
Selbin	Joel		DC_M1248	UCS	K.2.1
Selig	Kanti		DC_M4498	UCS	K.2.1
Sellers	Gayle		DC_M1640	UCS	K.2.1
Sellers	Jennifer		DC_M3566	UCS	K.2.1
Sellitto	Antoinette		DC_M1637	UCS	K.2.1
Sells	Greg		DC_M1404	UCS	K.2.1
Selten	Anne		DC_M3570	UCS	K.2.1
Seman	George		DC_M7771		K.2.1
Sennhauser	Robert		DC_M6342	UCS	K.2.1
Senuta	John		DC_M6386	UCS	K.2.1
Seppa	David		DC_M3532	UCS	K.2.1
Seraso	Laura		DC_M4799	UCS	K.2.1
Sergent	Jacqueline		DC_M4965	UCS	K.2.1

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Serim	Ari		DC_M5494	UCS	K.2.1
Serlin	Steve		DC_M0359		K.2.1
Serrano	Jennifer		DC_M3921	UCS	K.2.1
Sersig	Margery		DC_M5579	UCS	K.2.1
Servais	James		DC_M3917	UCS	K.2.1
Sessine	Linda		DC_M5325	UCS	K.2.1
Seth	Barry		DC_M7050	UCS	K.2.1
Severinghaus	Ed		DC_E0083		K.3.1, K.3.2, K.3.5, K.3.10, K.3.11, K.3.13
Sewell	Jerry W.		DC_M7450	UCS	K.2.1
Sewick	Karen		DC_M6409	UCS	K.2.1
Seymour	Donna		DC_M4522	UCS	K.2.1
Shackelford	Edgar		DC_M0020		K.3.1, K.3.2, K.3.7, K.3.12
Shafchuk	Patsy		DC_M7416	UCS	K.2.1
Shafer	James		DC_M7402	UCS	K.2.1
Shafer	Mary Frances		DC_M0246		K.2.2
Shafer	Mort		DC_M7932		K.2.3
Shafer	Padriac		DC_M6307	UCS	K.2.1
Shaffer	Barbara		DC_M4370	UCS	K.2.1
Shaffer	Janet		DC_M5605	UCS	K.2.1
Shafnisky	Luke		DC_M6557	UCS	K.2.1
Shafroth	Stephen		DC_M6919	UCS	K.2.1
Shain	Davira		DC_M5050	UCS	K.2.1
Shalda	Elise		DC_M3280	UCS	K.2.1
Shand	Sandra		DC_M6936	UCS	K.2.1
Shannon	Crystal		DC_M5886	UCS	K.2.1
Shapiro	Eve		DC_M5570	UCS	K.2.1
Shapiro	Gerrie		DC_M4851	UCS	K.2.1
Shapiro	Martin		DC_M3632	UCS	K.2.1
Shapland	James		DC_M4444	UCS	K.2.1
Sharkey	Debra		DC_M3699	UCS	K.2.1
Sharp	Ron		DC_M6388	UCS	K.2.1
Sharp	Stephen K		DC_M3243	UCS	K.2.1
Sharpes	Cara		DC_M7158	UCS	K.2.1
Shattls	Trudy		DC_M1213	UCS	K.2.1
Shatzkin	Earl H.		DC_M0832	UCS	K.2.1
Shaughnessy	Diane		DC_M4674	UCS	K.2.1
Shaver	Katherine		DC_M3837	UCS	K.2.1
Shaw	Angelina		DC_M0488		K.2.1
Shay-Tomer	Patricia		DC_M2438	UCS	K.2.1
Sheak	Bob		DC_M0594		K.2.1
Shearfor	Douglas H.		DC_M3919	UCS	K.2.1
Shedd	Elisabeth		DC_M2313	UCS	K.2.1
Shedd	Rebecca		DC_M5815	UCS	K.2.1
Shedd	Rebecca		DC_M6416	UCS	K.2.1
Sheilds	Mary		DC_E0105		K.3.2, K.3.3, K.3.9, K.3.10
Sheinwald	Ann		DC_M2643	UCS	K.2.1
Sheinwald	Ann		DC_M4811	UCS	K.2.1
Shelley	Ian		DC_M4453	UCS	K.2.1
Shelnett	Robert T		DC_M3012	UCS	K.2.1
Shelton	Carole L.		DC_M3314	UCS	K.2.1
Shelton	Dan		DC_E0167		K.3.14
Shelton	Mary		DC_M0423		K.2.1
Shelton	Mary		DC_M0424		K.2.1
Shelton	Mary		DC_M4741	UCS	K.2.1
Shelton	Mary		DC_M7502	UCS	K.2.1
Shenk	Patricia L.		DC_M4967	UCS	K.2.1
Shepard	John	Linda Shepard	DC_E0121		K.3.2, K.3.14
Shepherd	Elizabeth		DC_M0684		K.2.1

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Shepherd	Elizabeth		DC_M3182	UCS	K.2.1
Shepler	Joan		DC_M4077	UCS	K.2.1
Sheppard	Amy		DC_M6235	UCS	K.2.1
Sheppard	Amy		DC_M6236	UCS	K.2.1
Sheppard	Samona		DC_M6382	UCS	K.2.1
Sheppard	Somona		DC_M6384	UCS	K.2.1
Sheppard	Starr		DC_M4311	UCS	K.2.1
Sher	Steven		DC_M3367	UCS	K.2.1
Sherer	H		DC_M5821	UCS	K.2.1
Sheridan	Rose		DC_M5276	UCS	K.2.1
Sheridan	Ruth		DC_E0070		K.3.9
Sheridan	Ruth		DC_E0144		K.3.1, K.3.2, K.3.4, K.3.7, K.3.10, K.3.14
Sheridan	Suzanne		DC_M3984	UCS	K.2.1
Sherman	Carl		DC_M1644	UCS	K.2.1
Sherman	Diane		DC_M3145	UCS	K.2.1
Sherman	Eugenia B.		DC_M5201	UCS	K.2.1
Sherman	Harriet J.		DC_M5737	UCS	K.2.1
Sherman	Richard		DC_M6406	UCS	K.2.1
Sherriff	Steve		DC_M5597	UCS	K.2.1
Sherrill	Stephen		DC_M5445	UCS	K.2.1
Sherwood	Brian		DC_M2585	UCS	K.2.1
Sherwood	Courtney		DC_M4832	UCS	K.2.1
Sherwood	I-Hsien		DC_M4940	UCS	K.2.1
Shestak	Erica		DC_M0581		K.2.1
Shestak	Erica		DC_M1476	UCS	K.2.1
Shields	Lynne		DC_E0329		K.3.2, K.3.3, K.3.4, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15
Shihab	S		DC_M2220	UCS	K.2.1
Shimer	Sue		DC_M5282	UCS	K.2.1
Shin	Thomas		DC_M4434	UCS	K.2.1
Shine	Kim		DC_M3429	UCS	K.2.1
Shine	Patricia		DC_E0071	Lyndon State College	K.2.2
Shinnerl	Joseph		DC_M2175	UCS	K.2.1
Shinnerl	Mary		DC_M2268	UCS	K.2.1
Shipley	Scott		DC_M2387	UCS	K.2.1
Shirar	Alycia		DC_M1064	UCS	K.2.1
Shirey	Keith		DC_M2647	UCS	K.2.1
Shitama	Celeste		DC_M4147	UCS	K.2.1
Shively	Kelly		DC_M7683	UCS	K.2.1
Shively	Phyllis		DC_M4924	UCS	K.2.1
Shiverly	Daniel		DC_M0165		K.3.14
Shlackman	Mara		DC_M2943	UCS	K.2.1
Shockley	James		DC_M5577	UCS	K.2.1
Shockley	Mark		DC_M5670	UCS	K.2.1
Sholtz	Laura		DC_M0390		K.2.1
Shoop	Karen M.		DC_M1962	UCS	K.2.1
Shore	Joel		DC_M7753		K.2.1
Shoulderblade	Magoo		DC_M6840	UCS	K.2.1
Showers	Sterling		DC_M3768	UCS	K.2.1
Shrestha	Chauyen Lai		DC_E0010		K.3.5
Shridan	Suzanne		DC_M2637	UCS	K.2.1
Shroder	Jennifer	David Shroder	DC_M5132	UCS	K.2.1
Shroder	Jennifer	David Shroder	DC_M7094	UCS	K.2.1
Shuecraft	Steven Wayne		DC_M0170		K.2.1
Shuffler	Holly		DC_M2033	UCS	K.2.1
Shukla	H		DC_M5861	UCS	K.2.1
Shuler	Heidi		DC_M5829	UCS	K.2.1
Shumaker	Larry		DC_M5983	UCS	K.2.1

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Shumate	Charlene		DC_M5266	UCS	K.2.1
Shurr	Allison		DC_M5358	UCS	K.2.1
Sia	Tiffiny		DC_M1530	UCS	K.2.1
Sibley	Kate		DC_M5660	UCS	K.2.1
Sibus	Ashley		DC_M1748	UCS	K.2.1
Sickel	Stephen		DC_M7268	UCS	K.2.1
Sidari	Samantha		DC_M7117	UCS	K.2.1
Sidell	Gregory		DC_M3899	UCS	K.2.1
Sieffert	L.		DC_M5324	UCS	K.2.1
Siegan	Bruce		DC_M7560	UCS	K.2.1
Siegel	Larry		DC_M7906		K.2.1
Siegel	Lenny		DC_E0429		K.4
Siegel	Lenny		DC_PHW0004	Center for Public Environmental Oversight	K.3.15, K.4
Siegel	Sylvia		DC_M7945		K.2.1
Sienknecht	Nancy		DC_M4484	UCS	K.2.1
Sies	Richard		DC_M3187	UCS	K.2.1
Siewert	Rae Ann		DC_M1051	UCS	K.2.1
Sigmund	Chandra		DC_M0818	UCS	K.2.1
Sillars	Rodger		DC_M3241	UCS	K.2.1
Sillins	Stacy		DC_M3864	UCS	K.2.1
Silver	Karissa		DC_M0841	UCS	K.2.1
Silver	Myra		DC_M3373	UCS	K.2.1
Silver	Sandy		DC_M0046	Women's International League for Peace and Freedom, United States Section	K.3.1, K.3.2, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Silver	Sandy		DC_PHW0008	Women's Intenational Leauge Peace and Freedom	K.3.2, K.3.5, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Silvern	Robert		DC_M5386	UCS	K.2.1
Silvers	Rodger		DC_M7847		K.2.1
Silverstein	Sasha		DC_M5571	UCS	K.2.1
Silvis	Julia		DC_M4970	UCS	K.2.1
Simeone	Bruce		DC_E0314		K.2.2
Simmonds	Kathy		DC_M5039	UCS	K.2.1
Simmons	Carole		DC_M0407		K.2.1
Simmons	Carole		DC_M3229	UCS	K.2.1
Simmons	Judy		DC_M1578	UCS	K.2.1
Simon	N.		DC_M7340	UCS	K.2.1
Simons	Bette		DC_M4625	UCS	K.2.1
Simons	Sarah		DC_M4841	UCS	K.2.1
Simons	Dave		DC_M7518	UCS	K.2.1
Simonsen	Jill		DC_M5872	UCS	K.2.1
Simonson	Shawn	Denise Simonson	DC_M7005	UCS	K.2.1
Simpson	George		DC_M2845	UCS	K.2.1
Simpson	James		DC_M7154	UCS	K.2.1
Simpson	Walter		DC_M2419	UCS	K.2.1
Sims	Kate		DC_M5867	UCS	K.2.1
Sims	Stephanie		DC_M3607	UCS	K.2.1
Simshauser	Vanessa		DC_M6158	UCS	K.2.1
Sinclair	Carol D.		DC_M6741	UCS	K.2.1
Sinclair	Clara		DC_M0213		K.3.14
Sinclair	Michele		DC_M1183	UCS	K.2.1
Sindley	Heather		DC_M6375	UCS	K.2.1
Singer	Barb		DC_M7585	UCS	K.2.1
Singer	John		DC_M3557	UCS	K.2.1

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Singer	R.		DC_M5531	UCS	K.2.1
Sinks	Jennifer		DC_M1518	UCS	K.2.1
Sipress	Matthew		DC_M1834	UCS	K.2.1
Sirelson	Bernie		DC_M5656	UCS	K.2.1
Sitrick, Jr.	James B.		DC_M6628	UCS	K.2.1
Sitton	Ronald		DC_M1045	UCS	K.2.1
Sivel	Richard		DC_M5380	UCS	K.2.1
Sivesind	Torunn		DC_M6233	UCS	K.2.1
Skarda	Angi		DC_M1955	UCS	K.2.1
Skelton	Julie		DC_M1308	UCS	K.2.1
Skillman	Ermalee		DC_M0592		K.2.1
Skinder	Mark		DC_M5802	UCS	K.2.1
Skinner	Charles		DC_E0077		K.3.3, K.3.13, K.3.14
Skinner	Charles		DC_M0631		K.2.1
Skinner	Jaqueline		DC_E0327		K.3.4, K.3.7, K.3.11, K.3.12, K.3.15
Skinner	Sara		DC_M5616	UCS	K.2.1
Skipper	Elizabeth		DC_M1215	UCS	K.2.1
Sklar	Zach		DC_M4600	UCS	K.2.1
Skoglund	Sheryl R.		DC_M5285	UCS	K.2.1
Skoglund	Sheryl R.		DC_M5286	UCS	K.2.1
Slack	Robert		DC_M3085	UCS	K.2.1
Slack	Stephen		DC_M7745		K.2.1
Sladek	Phyllis		DC_M5694	UCS	K.2.1
Slaven	Charmaine		DC_M5545	UCS	K.2.1
Slawson	Bob		DC_M4516	UCS	K.2.1
Sleve	Lloyd		DC_M7252	UCS	K.2.1
Sleve	Patricia		DC_M6722	UCS	K.2.1
Sloan	Matthew		DC_M6901	UCS	K.2.1
Sloan	Rita		DC_M0928	UCS	K.2.1
Sloane	Jeanne		DC_M0668		K.2.1
Sloane	Marselle		DC_M4257	UCS	K.2.1
Slocum	Jessica		DC_M4206	UCS	K.2.1
Slof	Mike		DC_M5798	UCS	K.2.1
Slomovits	Helen		DC_M3794	UCS	K.2.1
Slonim	Tracey		DC_M6207	UCS	K.2.1
Slusarski	Yvette		DC_M5754	UCS	K.2.1
Small	Jack	Joyce Small	DC_E0294		K.3.2, K.3.3, K.3.10, K.3.11, K.3.15
Small	Karen		DC_E0111		K.2.3
Small	Tom		DC_M3852	UCS	K.2.1
Smarandoiu	Andrei		DC_M3781	UCS	K.2.1
Smith	Angela		DC_M1018	UCS	K.2.1
Smith	Angele		DC_M3409	UCS	K.2.1
Smith	Ann		DC_M2817	UCS	K.2.1
Smith	Barrie		DC_M6008	UCS	K.2.1
Smith	Brett		DC_M2459	UCS	K.2.1
Smith	Brian		DC_M0743		K.2.1
Smith	Brian		DC_M1589	UCS	K.2.1
Smith	Cathy		DC_M3047	UCS	K.2.1
Smith	Cha		DC_M7734		K.2.1
Smith	Colin		DC_M5052	UCS	K.2.1
Smith	Dakota		DC_M6228	UCS	K.2.1
Smith	Deborah		DC_M5395	UCS	K.2.1
Smith	Deborah		DC_M6252	UCS	K.2.1
Smith	Diana		DC_M4208	UCS	K.2.1
Smith	Ed		DC_M1290	UCS	K.2.1
Smith	Elena		DC_M2138	UCS	K.2.1
Smith	Ellen L		DC_M2188	UCS	K.2.1

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Smith	Elske		DC_M2640	UCS	K.2.1
Smith	Grace		DC_M7139	UCS	K.2.1
Smith	Gretle		DC_M7477	UCS	K.2.1
Smith	Janet		DC_M6000	UCS	K.2.1
Smith	Janice		DC_M5777	UCS	K.2.1
Smith	Kandler		DC_M6706	UCS	K.2.1
Smith	Kevin		DC_M5930	UCS	K.2.1
Smith	Kim		DC_M6768	UCS	K.2.1
Smith	Leigh		DC_M4447	UCS	K.2.1
Smith	Lowell		DC_M7913		K.2.1
Smith	M.M.K		DC_E0095		K.2.1
Smith	Margaret J.		DC_M4443	UCS	K.2.1
Smith	Marion		DC_M0215		K.3.1, K.3.14
Smith	Mark		DC_M6850	UCS	K.2.1
Smith	Mark S.		DC_M5299	UCS	K.2.1
Smith	Michele		DC_M4766	UCS	K.2.1
Smith	Molly		DC_M5628	UCS	K.2.1
Smith	Morton		DC_M1650	UCS	K.2.1
Smith	Morton		DC_M7071	UCS	K.2.1
Smith	Nancy		DC_M1067	UCS	K.2.1
Smith	Nate		DC_M2965	UCS	K.2.1
Smith	Paul		DC_M0688		K.2.1
Smith	Priscilla R.		DC_M5219	UCS	K.2.1
Smith	Ron		DC_M6783	UCS	K.2.1
Smith	Rosita A		DC_M2323	UCS	K.2.1
Smith	Sandy C.		DC_M1237	UCS	K.2.1
Smith	Sharon		DC_M2413	UCS	K.2.1
Smith	Sherry		DC_M4747	UCS	K.2.1
Smith	Stacey		DC_M2853	UCS	K.2.1
Smith	Stephen		DC_M5404	UCS	K.2.1
Smith	Suzanne		DC_M2752	UCS	K.2.1
Smith	Suzanne N.		DC_M5196	UCS	K.2.1
Smith	Suzanne N.		DC_M5197	UCS	K.2.1
Smith	Teresa		DC_M6468	UCS	K.2.1
Smith	Teresa		DC_M6469	UCS	K.2.1
Smith	Theresa		DC_M1031	UCS	K.2.1
Smith	Traude		DC_M0374		K.2.1
Smith	Trenton		DC_M3212	UCS	K.2.1
Smith	Valerie		DC_M0169		K.3.4, K.3.5, K.3.6, K.3.11, K.3.12, K.3.15
Smith	Valerie		DC_M2841	UCS	K.2.1
Smith	Wayne		DC_M2129	UCS	K.2.1
Smith	William		DC_M3437	UCS	K.2.1
Smith	William	Elaine Smith	DC_M7646	UCS	K.2.1
Smith-Bates	Lorrin		DC_M7346	UCS	K.2.1
Smith-Hundley	Kathy O		DC_M2088	UCS	K.2.1
Smithson	Jill		DC_M2248	UCS	K.2.1
Smoak	Copley		DC_M0543		K.2.1
Smolinsky	Gerald		DC_M0476		K.2.1
Smucker	Anna		DC_M1975	UCS	K.2.1
Smullin	Sylvia		DC_M7246	UCS	K.2.1
Smykal	Joyce		DC_M4081	UCS	K.2.1
Snavely	Nicholas		DC_M1164	UCS	K.2.1
Snawder	John		DC_M6660	UCS	K.2.1
Snoonian	Collette Legault		DC_M4327	UCS	K.2.1
Snow	Barbara		DC_M7169	UCS	K.2.1
Snow	Patricia		DC_M6405	UCS	K.2.1
Snowden	Patricia		DC_M3753	UCS	K.2.1
Snyder	Bradley K		DC_M2295	UCS	K.2.1

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Snyder	Carolyn		DC_M4894	UCS	K.2.1
Snyder	Judy	Wyane Snyder	DC_M0007		K.2.2
Snyder	Larry		DC_M0536		K.2.1
Snyder	Mark		DC_M7159	UCS	K.2.1
Snyder	Stephen		DC_M2568	UCS	K.2.1
Snyder	Stephen		DC_M5814	UCS	K.2.1
Snyder	Sueanne Kelsey		DC_M4315	UCS	K.2.1
Snyder	Sueanne Kelsey		DC_M5340	UCS	K.2.1
Snyder	Wendy		DC_M3205	UCS	K.2.1
Soares	Colleen		DC_M3518	UCS	K.2.1
Sobel	Scott		DC_M0883	UCS	K.2.1
Sober	Dottie		DC_M4729	UCS	K.2.1
Sobo	Naomi		DC_M7013	UCS	K.2.1
Sockrider	Dan		DC_M4103	UCS	K.2.1
Soderlind	Johan		DC_M2546	UCS	K.2.1
Soderman	Arne		DC_E0158		K.3.5, K.3.7, K.3.11, K.3.12, K.3.15, K.4
Sodos	Michael		DC_M1295	UCS	K.2.1
Sofie	Celia		DC_M4104	UCS	K.2.1
Sohn	Jeremy		DC_M0383		K.2.1
Soiferman	Layah		DC_M3233	UCS	K.2.1
Sokal	Judith		DC_M2466	UCS	K.2.1
Sokolow	Fred		DC_M4837	UCS	K.2.1
Solano	Francisco		DC_M4728	UCS	K.2.1
Solem	Bruce		DC_M3911	UCS	K.2.1
Soler	Ana Yong		DC_M7634	UCS	K.2.1
Soles	Ellen		DC_M6990	UCS	K.2.1
Sollars	Jim		DC_M2057	UCS	K.2.1
Sollenberger	Bruce		DC_PHO0042		K.3.2, K.3.3, K.3.4, K.3.10, K.3.11, K.3.13
Solomon	Beverly		DC_M6006	UCS	K.2.1
Solomon	Bruce		DC_M7137	UCS	K.2.1
Solomon	Phyllis		DC_M0140		K.2.1
Solovay	Mitchell		DC_E0285		K.2.2
Soltesz	Steven		DC_M1312	UCS	K.2.1
Soltis	M.B.		DC_M6795	UCS	K.2.1
Somer	Natalie		DC_M5805	UCS	K.2.1
Sommer	Catherine		DC_M5957	UCS	K.2.1
Sommer	Marc		DC_M3931	UCS	K.2.1
Sommerfield	Thomas		DC_M0422		K.2.1
Sonne	Liana		DC_M2889	UCS	K.2.1
Sonneborn	David		DC_M1443	UCS	K.2.1
Sonnino	Valerie		DC_M5573	UCS	K.2.1
Sonsteng	Melanie		DC_M1506	UCS	K.2.1
Sood	Lisa		DC_M1683	UCS	K.2.1
Soos	Joyce		DC_M5985	UCS	K.2.1
Soper	Robert A.		DC_M3359	UCS	K.2.1
Soreil	B.		DC_M3789	UCS	K.2.1
Sorgen	Phoebe		DC_M3028	UCS	K.2.1
Sornsilp	Vickie		DC_M1415	UCS	K.2.1
Sosa	Hector		DC_M1178	UCS	K.2.1
Soskolne	Lise		DC_M3349	UCS	K.2.1
Soth	Carol		DC_M1904	UCS	K.2.1
Sousa	Rich		DC_M2598	UCS	K.2.1
South	Gail		DC_M3982	UCS	K.2.1
South	Mary J.		DC_M3337	UCS	K.2.1
South	Sylvia		DC_M1073	UCS	K.2.1
South	Jennifer		DC_M2207	UCS	K.2.1
Southard	Mary		DC_M2892	UCS	K.2.1

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Souther	Gail		DC_M0144		K.3.14
Southwick	Alan		DC_M5991	UCS	K.2.1
Sowa-Maksic	Christopher		DC_M1392	UCS	K.2.1
Sowell	Mark		DC_M0377		K.2.1
Sower	David		DC_M0583		K.2.1
Soyama	Takuji		DC_M2961	UCS	K.2.1
Spacek	Steve		DC_M7750		K.2.1
Spadola	Suzanne		DC_M5192	UCS	K.2.1
Spagnoli	Harriet		DC_M5120	UCS	K.2.1
Spalding	Kathleen		DC_M2342	UCS	K.2.1
Spall	James		DC_M6673	UCS	K.2.1
Spallina	Jann		DC_M4589	UCS	K.2.1
Sparks	Margaret		DC_M1810	UCS	K.2.1
Sparks	Melissa		DC_M1095	UCS	K.2.1
Spaulding	Kathryn		DC_M3969	UCS	K.2.1
Spaulding	Ruth		DC_M3912	UCS	K.2.1
Spaulding	Ruth		DC_M4002	UCS	K.2.1
Spearow	Jimmy		DC_E0427	PSR (member)	K.3.4, K.3.5, K.3.9, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Spearow	Jimmy		DC_E0439		K.3.4, K.3.5, K.3.9, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Spearow	Jimmy		DC_E0443		K.3.9
Spearow	Jimmy		DC_PHO0011		K.3.4, K.3.11, K.3.15, K.4
Spears	Nancy		DC_M6364	UCS	K.2.1
Spears	Priscilla		DC_M5897	UCS	K.2.1
Speck	Monica		DC_M6974	UCS	K.2.1
Speitel	Michael		DC_M6136	UCS	K.2.1
Spence	Jack		DC_M4190	UCS	K.2.1
Spencer	Dawn		DC_M3529	UCS	K.2.1
Spencer	Miriam		DC_M3452	UCS	K.2.1
Spendelow	Jeff		DC_M6819	UCS	K.2.1
Spickard	Sarah		DC_M1021	UCS	K.2.1
Spielman	Eric		DC_M4207	UCS	K.2.1
Spiert	Vincent		DC_M2186	UCS	K.2.1
Spinney	Jane		DC_M5145	UCS	K.2.1
Spinney	Jane		DC_M5165	UCS	K.2.1
Spirito	Janice C.		DC_M1274	UCS	K.2.1
Spitzer	Susan		DC_M5681	UCS	K.2.1
Spivack	Freddie		DC_M0623		K.2.1
Spivey	D.		DC_M4814	UCS	K.2.1
Spradling	Richard D.		DC_M7065	UCS	K.2.1
Sprague	Gretchen		DC_M2123	UCS	K.2.1
Sprague	Philip		DC_M3295	UCS	K.2.1
Springer	William		DC_M7860		K.2.1
Squire	Blanche P.		DC_M7077	UCS	K.2.1
Squire	S		DC_M6925	UCS	K.2.1
St Clair	Joseph		DC_M3235	UCS	K.2.1
St. Clair	Taylor		DC_M2783	UCS	K.2.1
St. Cyr	Jeanne		DC_M6528	UCS	K.2.1
St. Jean	Constance		DC_M0186		K.3.2, K.3.14
St. Louis	Marsha		DC_M5072	UCS	K.2.1
St. Pierre	Leslie		DC_M4670	UCS	K.2.1
St. Pierre	Leslie		DC_M5479	UCS	K.2.1
Staaf	Linda		DC_M5816	UCS	K.2.1
Staats	Gwen		DC_M0786	UCS	K.2.1
Stacey	McRae		DC_M3822	UCS	K.2.1
Stackkman	Marshall S		DC_M2221	UCS	K.2.1

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Stafford	Nathaniel		DC_M7583	UCS	K.2.1
Stafford	Venus		DC_M5267	UCS	K.2.1
Stahl	Charlotte		DC_M5576	UCS	K.2.1
Stahl	Jeffrey		DC_M4658	UCS	K.2.1
Stahl	Tashery		DC_M3488	UCS	K.2.1
Stahler	Alan		DC_PHO0005		K.3.3, K.3.11, K.3.13, K.3.15
Stahlheber	Elaine Ann		DC_M7604	UCS	K.2.1
Stair	Judith		DC_M7057	UCS	K.2.1
Stakely	Rheua S.		DC_M3947	UCS	K.2.1
Staley	Claire		DC_M1132	UCS	K.2.1
Stallworth	Carol		DC_M0942	UCS	K.2.1
Stambaugh	Susan		DC_M5091	UCS	K.2.1
Stanback	Brad		DC_M6737	UCS	K.2.1
Standi	Ilona		DC_M1166	UCS	K.2.1
Standring	Patricia		DC_M4644	UCS	K.2.1
Standring	Patricia		DC_M4660	UCS	K.2.1
Stanfield	Edwin		DC_M5931	UCS	K.2.1
Stanfield	Gary		DC_M7334	UCS	K.2.1
Stanford	George		DC_E0098		K.3.10
Stankavage	JoAnn		DC_M4256	UCS	K.2.1
Stanley	Anie		DC_M4188	UCS	K.2.1
Stanton	Lisa		DC_M2721	UCS	K.2.1
Stanton	Staci		DC_M5585	UCS	K.2.1
Stanton	Staci		DC_M5608	UCS	K.2.1
Stanzione	Dawn		DC_M1988	UCS	K.2.1
Stark	Eleanor		DC_M5718	UCS	K.2.1
Starke-Livermore	Shanna		DC_M3173	UCS	K.2.1
Starr	Frank		DC_M6122	UCS	K.2.1
Starr	Jene'		DC_M1663	UCS	K.2.1
Starr	Julie		DC_M3190	UCS	K.2.1
Starrett	Nancy		DC_M7236	UCS	K.2.1
Stask	Diana		DC_M0790	UCS	K.2.1
Stassinos	Gerry		DC_M1105	UCS	K.2.1
Stately	Amber		DC_M2866	UCS	K.2.1
Statman	Paul		DC_M6631	UCS	K.2.1
Stauber	Della		DC_M3637	UCS	K.2.1
Stauber	Della		DC_M4896	UCS	K.2.1
Stauffer	Wendie		DC_M1884	UCS	K.2.1
Stavis	Alex		DC_M7659	UCS	K.2.1
Stearns	Luke		DC_M3381	UCS	K.2.1
Stebbins	Emma		DC_M2252	UCS	K.2.1
Stebler	Timothy		DC_M1720	UCS	K.2.1
Steele	Debbie		DC_M0404		K.2.1
Steele	Joanne		DC_M1608	UCS	K.2.1
Steele	Sharon		DC_M5813	UCS	K.2.1
Steen	Kevin		DC_M5527	UCS	K.2.1
Steensma	Monica		DC_M7615	UCS	K.2.1
Stefano	Courtney		DC_M4662	UCS	K.2.1
Steffy	Susan		DC_M3125	UCS	K.2.1
Stein	Diane		DC_M5475	UCS	K.2.1
Stein	Eric		DC_M2689	UCS	K.2.1
Stein	MaryJo		DC_M1331	UCS	K.2.1
Stein	Michael		DC_M7296	UCS	K.2.1
Steinbach	Kurt D		DC_M3202	UCS	K.2.1
Steinwinder	Eric		DC_M7635	UCS	K.2.1
Steitz	Martin		DC_M0041		K.2.1
Stenflo	Jan		DC_M1173	UCS	K.2.1
Stenger	Joseph		DC_M7854		K.2.1
Stepanski	D M		DC_M6884	UCS	K.2.1

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Stephanopoulos	Maria		DC_M1846	UCS	K.2.1
Stephanson	Sarah		DC_M2485	UCS	K.2.1
Stephens	Don		DC_E0262		K.4
Stephens	Maria		DC_M5772	UCS	K.2.1
Stephenson	John		DC_M1169	UCS	K.2.1
Steranko	Marilyn		DC_M2589	UCS	K.2.1
Stern	Annelore		DC_M0304		K.2.1
Stern	Joe		DC_E0197		K.3.1, K.3.11
Stern	Sue		DC_M3462	UCS	K.2.1
Stern	Susan		DC_M3370	UCS	K.2.1
Sternman	William		DC_M1270	UCS	K.2.1
Steussy	Helen		DC_M7761		K.2.1
Stevens	Anne		DC_E0255		K.3.2, K.3.11, K.3.12
Stevens	Daphne T.		DC_M0660		K.2.1
Stevens	Jessica		DC_M5811	UCS	K.2.1
Stevens	Paula		DC_M5218	UCS	K.2.1
Steward	R M		DC_M5254	UCS	K.2.1
Stewart	Carrie L.		DC_M4036	UCS	K.2.1
Stewart	Glenn		DC_M3992	UCS	K.2.1
Stewart	Jeffery		DC_M5674	UCS	K.2.1
Stewart	John		DC_M7937		K.3.2, K.3.7, K.3.10, K.3.13, K.3.15
Stewart	June		DC_M4131	UCS	K.2.1
Stewart	Richard		DC_M1189	UCS	K.2.1
Stewart	Robert and Linda		DC_M1895	UCS	K.2.1
Sthokal	Randy		DC_M5830	UCS	K.2.1
Stiegleiter	Stacy		DC_M0590		K.2.1
Stiegler	Kristen		DC_M5635	UCS	K.2.1
Stienman	Michael		DC_M6811	UCS	K.2.1
Stine	William		DC_M1856	UCS	K.2.1
Stinnett	Brian		DC_M0675		K.2.1
Stinson-Hawn	Kim		DC_M0747		K.2.1
Stirba	Clifford		DC_M0185		K.3.14
Stires	Rondi		DC_M5546	UCS	K.2.1
Stock	Janalee		DC_M5630	UCS	K.2.1
Stock	Stephanie		DC_M6767	UCS	K.2.1
Stockbridge	Miriam		DC_M0295		K.3.1, K.3.2, K.3.11, K.3.12
Stocks	Jackie		DC_M5896	UCS	K.2.1
Stocks	Peter		DC_M2486	UCS	K.2.1
Stockton	Daniel		DC_M4057	UCS	K.2.1
Stoffel	Patrick		DC_M4231	UCS	K.2.1
Stoffer	Ted		DC_M1074	UCS	K.2.1
Stofiel	Mike		DC_M0446		K.2.1
Stojak	Mark		DC_M5272	UCS	K.2.1
Stoll	Colin		DC_M7480	UCS	K.2.1
Stollenwerk	Scott		DC_M5919	UCS	K.2.1
Stone	Albert		DC_M5707	UCS	K.2.1
Stone	Benjamin		DC_M6720	UCS	K.2.1
Stone	Gaynell		DC_M7249	UCS	K.2.1
Stone	George T.		DC_M0551		K.2.1
Stone	Jill M.		DC_M7038	UCS	K.2.1
Stone	Meredith		DC_M1505	UCS	K.2.1
Stonebraker	Alyson		DC_M6460	UCS	K.2.1
Stoops	Donald		DC_M3020	UCS	K.2.1
Stoor	April		DC_M1055	UCS	K.2.1
Storino	Michael		DC_M0868	UCS	K.2.1
Storm	Tessa		DC_M3489	UCS	K.2.1
Stosch	William		DC_M4594	UCS	K.2.1

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Stoudt	John		DC_M1797	UCS	K.2.1
Stoughton	MaryLouise		DC_M2270	UCS	K.2.1
Stout	Chuck		DC_M0596		K.2.1
Stowe	Jane		DC_M3976	UCS	K.2.1
Strachan	Don		DC_M0065		K.2.1
Strange	Linda		DC_M0762		K.2.1
Strasser	Bob		DC_M1383	UCS	K.2.1
Stratton	Jewels		DC_M1442	UCS	K.2.1
Straub	Caroline		DC_M0365		K.2.1
Straub	Caroline		DC_M1763	UCS	K.2.1
Straub	Gwen Pallante		DC_M5075	UCS	K.2.1
Strauss	Julie		DC_M6005	UCS	K.2.1
Strebeck	Robert		DC_M7404	UCS	K.2.1
Strehlow	Laura		DC_M7366	UCS	K.2.1
Strickland	Jennifer		DC_M4395	UCS	K.2.1
Strini	Thomas		DC_M3671	UCS	K.2.1
Strobel	Melissa		DC_M6625	UCS	K.2.1
Stroecker	Linda		DC_M4984	UCS	K.2.1
Strong	Ann		DC_M1632	UCS	K.2.1
Strother	Gordon		DC_M4052	UCS	K.2.1
Stroud	Sally		DC_M1090	UCS	K.2.1
Stroupe	Kerri		DC_M3213	UCS	K.2.1
Strouts	LM		DC_M7267	UCS	K.2.1
Strum	Daniel		DC_M6488	UCS	K.2.1
Struthers	Sue		DC_M3240	UCS	K.2.1
Stryker	Vic		DC_M0630		K.2.1
Stuart	Anne		DC_M1812	UCS	K.2.1
Stuart	Glenn		DC_M4483	UCS	K.2.1
Stuart	Peter	Vicky Stuart	DC_M1264	UCS	K.2.1
Stubblefield	Adrian		DC_M2336	UCS	K.2.1
Stubblefield	Kerri		DC_M4630	UCS	K.2.1
Stucke	Harriet		DC_M1172	UCS	K.2.1
Stucklen	Claire		DC_M6031	UCS	K.2.1
Studtmann	David		DC_M0636		K.2.1
Stull	Rita		DC_M2629	UCS	K.2.1
Stuphin	Madelaine		DC_M0836	UCS	K.2.1
Sturges	Laurel C.		DC_M7096	UCS	K.2.1
Sturgill	Michele		DC_M5083	UCS	K.2.1
Sturm	Lois		DC_M7251	UCS	K.2.1
Sturnick	Mark		DC_M0284		K.3.10, K.3.14
Sudbury	Heather		DC_M7914		K.2.1
Sudderth	Philip R.		DC_M6970	UCS	K.2.1
Sugar	Anne		DC_M6821	UCS	K.2.1
Suhr	Linda		DC_M3245	UCS	K.2.1
Sukolsky	Brad		DC_M3385	UCS	K.2.1
Sulak	Dustin		DC_M7082	UCS	K.2.1
Sulanke	Thom		DC_M0306		K.2.1
Sullivan	Daniel		DC_M2890	UCS	K.2.1
Sullivan	Daniel		DC_M2891	UCS	K.2.1
Sullivan	Kristin		DC_M2542	UCS	K.2.1
Sullivan	Lauren		DC_M3952	UCS	K.2.1
Sullivan	M.C.		DC_M0430		K.2.1
Sullivan	Neil		DC_M3808	UCS	K.2.1
Sulock	Dorothy		DC_M4462	UCS	K.2.1
Sulzman	Christina		DC_M6905	UCS	K.2.1
Sumii	Miya		DC_M0052		K.2.1
Summer	Rebecca		DC_M4992	UCS	K.2.1
Summers	JR		DC_M7265	UCS	K.2.1
Summers	Mary		DC_M0800	UCS	K.2.1

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Sumner	Noreen		DC_E0146		K.2.2
Sun	Nida		DC_M2580	UCS	K.2.1
Sundberg	Clifford		DC_M7928		K.2.3
Sunderman	Carole		DC_M0047		K.2.2
Sundquist	Eric		DC_M5558	UCS	K.2.1
Sundquist	Sunny		DC_M5495	UCS	K.2.1
Sunflame	Brigit		DC_M7749		K.2.1
Sunshine	Jane		DC_M4867	UCS	K.2.1
Supernant	Rachel		DC_M1246	UCS	K.2.1
Surette	John		DC_M2399	UCS	K.2.1
Surprenant	Rachel		DC_M0499		K.2.1
Susan	McMillan		DC_M0852	UCS	K.2.1
Susman	Millard		DC_E0096		K.3.2, K.3.4, K.3.7, K.3.10, K.3.11, K.3.13
Sutaria	Shreeraj		DC_M5998	UCS	K.2.1
Sutcliffe	Renae		DC_M5626	UCS	K.2.1
Suter	Emanuel		DC_M0329		K.2.1
Sutherland	Laura		DC_M2100	UCS	K.2.1
Sutliffe	Pat		DC_M1002	UCS	K.2.1
Sutphin	Andrew		DC_M4941	UCS	K.2.1
Sutton	Claudette		DC_M3661	UCS	K.2.1
Sutton	Ellyn		DC_M4226	UCS	K.2.1
Sutton	JoAnne		DC_M4468	UCS	K.2.1
Svoboda	Michael		DC_M6278	UCS	K.2.1
Swab	Leah		DC_M2233	UCS	K.2.1
Swan	Charles		DC_E0025		K.2.2
Swanick	Theresa		DC_M4049	UCS	K.2.1
Swank	Bonnie		DC_M7291	UCS	K.2.1
Swank	Phyllis		DC_M3851	UCS	K.2.1
Swanson	Erik		DC_M3005	UCS	K.2.1
Swanson	Michael		DC_M7709		K.2.1
Swanson	Miriam		DC_M2796	UCS	K.2.1
Swanson	Vanessa S		DC_M3137	UCS	K.2.1
Sward	Jean		DC_M0066		K.2.1
Sward	Leesa		DC_M7464	UCS	K.2.1
Swartz	Tony		DC_M5112	UCS	K.2.1
Sweeney	Ellen		DC_M7935		K.2.1
Sweeney	Katherine		DC_M5426	UCS	K.2.1
Sweet	Grace		DC_M7280	UCS	K.2.1
Sweetser	Thomas		DC_E0241		K.2.2
Swei	Andrea		DC_M7946		K.2.3
Sweitzer	Hannah		DC_M2153	UCS	K.2.1
Swenson	Gordon J.		DC_M4187	UCS	K.2.1
Swida	M		DC_M2472	UCS	K.2.1
Swida	M		DC_M2479	UCS	K.2.1
Swift	Ronna J.		DC_M7660	UCS	K.2.1
Swindlehurst	Susan		DC_M3013	UCS	K.2.1
Swoboda	Lois		DC_M5877	UCS	K.2.1
Swyers	Nancy		DC_M2213	UCS	K.2.1
Syed	Amina		DC_M1752	UCS	K.2.1
Sykes	Chris		DC_M2918	UCS	K.2.1
Sylvester	Stephen		DC_M4703	UCS	K.2.1
Syres	Matthew		DC_M7561	UCS	K.2.1
Szalay	Amy		DC_M5981	UCS	K.2.1
Szendroi	Annamaria		DC_M4552	UCS	K.2.1
Szpanelewski	Cynthia		DC_M3208	UCS	K.2.1
T	Nancy		DC_M2113	UCS	K.2.1
Tabachnick	Paul		DC_M5251	UCS	K.2.1
Tabb	Linda		DC_M1671	UCS	K.2.1

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Tabor	Jeremy		DC_M7895		K.2.3
Tackes	Jim	Rosemary Tackes	DC_E0210		K.2.2
Taggart	Carol J.		DC_M1582	UCS	K.2.1
Taggert	Deborah		DC_M4583	UCS	K.2.1
Taglienti	Richard		DC_M6657	UCS	K.2.1
Tait	David		DC_M6596	UCS	K.2.1
Takagi	Richard		DC_M3960	UCS	K.2.1
Takatsch	Julie		DC_M5473	UCS	K.2.1
Talbot	Ashley		DC_M3136	UCS	K.2.1
Talbot	Nancy		DC_M2156	UCS	K.2.1
Talbott	Debbie		DC_M4731	UCS	K.2.1
Tallerinio	Eugene		DC_M3818	UCS	K.2.1
Tallerino	Carole		DC_M3830	UCS	K.2.1
Tallerino	Toni		DC_M6334	UCS	K.2.1
Talley	Tamera		DC_M6298	UCS	K.2.1
Tallow	Samuel		DC_M7341	UCS	K.2.1
Talmage	Elizabeth		DC_M5638	UCS	K.2.1
Talmage	Taormina		DC_M7253	UCS	K.2.1
Tamm	Ryan		DC_M3592	UCS	K.2.1
Tamres	Marilyn		DC_M3253	UCS	K.2.1
Tan	Frances		DC_M2840	UCS	K.2.1
Tang	Amy		DC_M7732		K.2.1
Tang	Henry		DC_M7425	UCS	K.2.1
Tanke	John		DC_M4619	UCS	K.2.1
Tannenbaum	Stanley		DC_M0291		K.3.2, K.3.10, K.3.13, K.3.14
Tansy	Kelly		DC_M6146	UCS	K.2.1
Tante	Carole		DC_M4886	UCS	K.2.1
Tao	Kazuko		DC_M5528	UCS	K.2.1
Tapp	Jack		DC_M2189	UCS	K.2.1
Tarajkowski	Lila		DC_M4884	UCS	K.2.1
Tarajkowski	Lila		DC_M6801	UCS	K.2.1
Taranow	Gerda		DC_M5001	UCS	K.2.1
Tarasoff	Norine		DC_M0973	UCS	K.2.1
Tardino-Hemerlein	Jeri		DC_M3157	UCS	K.2.1
Targon	Elvira		DC_M5457	UCS	K.2.1
Targon	Leah		DC_M2420	UCS	K.2.1
Tarnowski	Lori		DC_M1832	UCS	K.2.1
Tate	Carrie		DC_M4171	UCS	K.2.1
Tatum	Jim		DC_M4762	UCS	K.2.1
Tatum	Nadine		DC_M4582	UCS	K.2.1
Taulman	Janine		DC_M6629	UCS	K.2.1
Tava	Jennifer		DC_M2753	UCS	K.2.1
Tayler-Houle	Catherine		DC_M0628		K.2.1
Tayler-Houle	Catherine		DC_M1905	UCS	K.2.1
Taylor	Aileen		DC_M5940	UCS	K.2.1
Taylor	Carolyn		DC_M3817	UCS	K.2.1
Taylor	Carolyn		DC_M7829		K.2.1
Taylor	Diane		DC_M2187	UCS	K.2.1
Taylor	Karen		DC_M3436	UCS	K.2.1
Taylor	Kristina		DC_M4217	UCS	K.2.1
Taylor	Lee		DC_M3896	UCS	K.2.1
Taylor	Linda		DC_M0947	UCS	K.2.1
Taylor	Pamela		DC_M5537	UCS	K.2.1
Taylor	Patricia		DC_M0943	UCS	K.2.1
Taylor	Quinn		DC_M6292	UCS	K.2.1
Taylor	Robyn		DC_M2115	UCS	K.2.1
Taylor	Sarah		DC_M2919	UCS	K.2.1
Taylor	Sherry Horne		DC_M1592	UCS	K.2.1
Taylor	Sherry Horne		DC_M7178	UCS	K.2.1

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Taylor	William		DC_M4366	UCS	K.2.1
Taylor	Willie		DC_M0275	United States Department of the Interior	K.5
Teach	Erika		DC_M4414	UCS	K.2.1
Teasley	Regi		DC_M1824	UCS	K.2.1
Teasley	William		DC_M3131	UCS	K.2.1
Teglkamp	Lone		DC_M2991	UCS	K.2.1
Temple	Rob		DC_M0353		K.2.1
Templin	Orletta		DC_M4909	UCS	K.2.1
TenBrook	Jonathan		DC_M6691	UCS	K.2.1
Tennant	Eileen		DC_M1437	UCS	K.2.1
Tennyson	Sharon		DC_M3720	UCS	K.2.1
Tepe	Z		DC_M7221	UCS	K.2.1
Terhark	Theresa		DC_M6995	UCS	K.2.1
Teri	Michele		DC_M1545	UCS	K.2.1
Terra	Aileen		DC_M6012	UCS	K.2.1
Terrell	Melanie		DC_M0905	UCS	K.2.1
Terry	Darlene		DC_M7542	UCS	K.2.1
Terry	Judith L.		DC_M7368	UCS	K.2.1
Terry	Terelle		DC_M3918	UCS	K.2.1
Teshu	Susan		DC_M0837	UCS	K.2.1
Tessnow	Heike		DC_M5103	UCS	K.2.1
Testolin	Angela		DC_M7533	UCS	K.2.1
Tettlebaum	Ben		DC_M2370	UCS	K.2.1
Teutsch	Sallie		DC_M0413		K.2.1
Thatcher	Diana L.		DC_M6562	UCS	K.2.1
Thau	Paul		DC_M2715	UCS	K.2.1
Theresa	Futroye-Micus		DC_M0013		K.3.1, K.3.11, K.3.12
Therese	Maria		DC_M5770	UCS	K.2.1
Therien	Warren		DC_M3722	UCS	K.2.1
Thibodeaux	David		DC_M0308		K.2.1
Thie	Julia		DC_M2552	UCS	K.2.1
Thiele	B.F.		DC_M4526	UCS	K.2.1
Thiesen	Lauren		DC_M4070	UCS	K.2.1
this section blank			DC_M5407	UCS	K.2.1
Thom	Arleen		DC_M1317	UCS	K.2.1
Thom	Arleen		DC_M6315	UCS	K.2.1
Thomas	Autumn		DC_M4786	UCS	K.2.1
Thomas	Betty		DC_M3799	UCS	K.2.1
Thomas	Cathy L.		DC_M0865	UCS	K.2.1
Thomas	Cynthia		DC_E0213		K.2.2
Thomas	Dennis		DC_M0259		K.3.7, K.3.14, K.3.15
Thomas	Dennis		DC_M1550	UCS	K.2.1
Thomas	Dennis		DC_M1703	UCS	K.2.1
Thomas	Donna		DC_M1967	UCS	K.2.1
Thomas	Erika J.		DC_M7624	UCS	K.2.1
Thomas	Helen		DC_M5359	UCS	K.2.1
Thomas	Helen		DC_M7351	UCS	K.2.1
Thomas	J		DC_M4932	UCS	K.2.1
Thomas	Jennifer		DC_M1728	UCS	K.2.1
Thomas	Joseph		DC_M3923	UCS	K.2.1
Thomas	Karam		DC_M4683	UCS	K.2.1
Thomas	Kathryn		DC_M3083	UCS	K.2.1
Thomas	Kevin		DC_M7283	UCS	K.2.1
Thomas	Kimberley		DC_M6426	UCS	K.2.1
Thomas	Larry		DC_M1527	UCS	K.2.1
Thomas	Pamala		DC_M5599	UCS	K.2.1
Thomas	Rebecca		DC_M0672		K.2.1

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Thomas	Rick		DC_PHO0033		K.3.2, K.3.3, K.3.9, K.3.10
Thomas	Robert		DC_M5477	UCS	K.2.1
Thomas	Rory		DC_M0647		K.2.1
Thomas	Susan		DC_M4871	UCS	K.2.1
Thomas	Thomas		DC_M2503	UCS	K.2.1
Thomas	Toni		DC_M5137	UCS	K.2.1
Thomas	WEG		DC_M4010	UCS	K.2.1
Thomas	Yvonne		DC_M0920	UCS	K.2.1
Thomasson	Catherine		DC_E0402	Oregon Physicians for Social Responsibility	K.3.2, K.3.3, K.3.5, K.3.10, K.3.11, K.3.15, K.4
Thompsen	Kara		DC_M7362	UCS	K.2.1
Thompson	Alexis		DC_M2810	UCS	K.2.1
Thompson	Alice		DC_M4263	UCS	K.2.1
Thompson	Brian		DC_M1685	UCS	K.2.1
Thompson	Cheryl		DC_M3251	UCS	K.2.1
Thompson	Donna		DC_M7045	UCS	K.2.1
Thompson	Elaine		DC_M0440		K.2.1
Thompson	Elaine		DC_M7185	UCS	K.2.1
Thompson	Eric		DC_M0495		K.2.1
Thompson	Heidi		DC_M0926	UCS	K.2.1
Thompson	Howard		DC_M3438	UCS	K.2.1
Thompson	Joseph		DC_M0612		K.2.1
Thompson	Karen		DC_M6642	UCS	K.2.1
Thompson	Larry		DC_M7488	UCS	K.2.1
Thompson	Leslie		DC_M4650	UCS	K.2.1
Thompson	Linda I.		DC_M5269	UCS	K.2.1
Thompson	Linda I.		DC_M7673	UCS	K.2.1
Thompson	Marianne		DC_M4898	UCS	K.2.1
Thompson	Mary		DC_M6105	UCS	K.2.1
Thompson	Mary K		DC_M3413	UCS	K.2.1
Thompson	Scott		DC_M1864	UCS	K.2.1
Thompson	Stephen		DC_M5233	UCS	K.2.1
Thompson	Wayne		DC_M2751	UCS	K.2.1
Thompson-Wilding	Ann		DC_M6710	UCS	K.2.1
Thomson	Armida		DC_M6111	UCS	K.2.1
Thomson	Scott		DC_M1909	UCS	K.2.1
Thorman	Dorothy		DC_M0271		K.3.2, K.3.14
Thorne	Eve		DC_M5077	UCS	K.2.1
Thorne	Marisa		DC_M6839	UCS	K.2.1
Thornhill	CP		DC_M5180	UCS	K.2.1
Thoron	Janeth		DC_M6860	UCS	K.2.1
Thorp	John K.		DC_M7639	UCS	K.2.1
Thorpe	Y. Sue		DC_E0430		K.2.2
Thulin	Frederick		DC_M5461	UCS	K.2.1
Thyme	Lauren		DC_M0318		K.2.1
Tibbits	Greg		DC_M4790	UCS	K.2.1
Ticktin	Estelle		DC_M0557		K.2.1
Tidd	Amy		DC_M6609	UCS	K.2.1
Tidd	Robert		DC_M2905	UCS	K.2.1
Tifford	Paul		DC_M3463	UCS	K.2.1
Tilley	Merritt E.		DC_M5715	UCS	K.2.1
Tillotson	Christina		DC_M7941		K.2.1
Timmons	James		DC_M7885		K.2.1
Tindall	Heather		DC_M7524	UCS	K.2.1
Tindall-Gibson	Rosemary		DC_M6981	UCS	K.2.1
Tipp	L. Ilona		DC_M0850	UCS	K.2.1
Tirone	Paris		DC_M6637	UCS	K.2.1
Tizard	Thomas		DC_M6425	UCS	K.2.1

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Tjessem	Sandra		DC_M3492	UCS	K.2.1
Toal	Christopher		DC_M0915	UCS	K.2.1
Todd	Kalita		DC_M3922	UCS	K.2.1
Todirita	Katherine		DC_M2290	UCS	K.2.1
Tognoli	Stephen		DC_M4168	UCS	K.2.1
Tokugawa	Diane		DC_M3077	UCS	K.2.1
Tokuyasu	Taku		DC_M1693	UCS	K.2.1
Tomac	Helen		DC_M5776	UCS	K.2.1
Tomaro	Daniel		DC_M3668	UCS	K.2.1
Tomczak	L		DC_M3675	UCS	K.2.1
Tomkiel	Stanley		DC_M7909		K.2.1
Tomkosky	Lisa		DC_M4764	UCS	K.2.1
Tomkosky	Lisa		DC_M4788	UCS	K.2.1
Tomlin	Patricia		DC_M6630	UCS	K.2.1
Tomlinson	Philip		DC_M7692		K.2.1
Tompkins	Amy		DC_M1742	UCS	K.2.1
Tompkins	John		DC_M0705		K.2.1
Tonningsen	Barbara	Ed Tonningsen	DC_M7435	UCS	K.2.1
Toobert	Michael		DC_M7079	UCS	K.2.1
Toot	Erin		DC_M3950	UCS	K.2.1
Topper	Gwen		DC_M0999	UCS	K.2.1
Torrance	Jerry		DC_M1723	UCS	K.2.1
Torres	Arturo		DC_M4697	UCS	K.2.1
Torres	Priscilla		DC_M6487	UCS	K.2.1
Torres	Susan		DC_M1094	UCS	K.2.1
Torres	Veronica		DC_M7208	UCS	K.2.1
Tostenson	Kim		DC_M2916	UCS	K.2.1
Tostenson	Kim		DC_M2917	UCS	K.2.1
Tostenson	Kim		DC_M5402	UCS	K.2.1
Townsend	Darlene		DC_M4376	UCS	K.2.1
Townsend	Kristine		DC_M1862	UCS	K.2.1
Townsend	Marti		DC_PHO0048		K.3.15, K.4
Townsend	Patricia A.		DC_M0991	UCS	K.2.1
Towson	Roger		DC_M0451		K.2.1
Trachsel	Gay		DC_M2758	UCS	K.2.1
Tracy	Julia		DC_M0871	UCS	K.2.1
Trail	Pepper		DC_M3165	UCS	K.2.1
Trainor	Jean		DC_M1273	UCS	K.2.1
Trammell	Ryan		DC_M0619		K.2.1
Tran	Thuha		DC_M2053	UCS	K.2.1
Trau	Candis		DC_M2004	UCS	K.2.1
Traversa	Catherine		DC_M4235	UCS	K.2.1
Traversa	Stephanie		DC_M1882	UCS	K.2.1
Travis-Morgan	Donna Mae		DC_M6373	UCS	K.2.1
Treadway	Richard		DC_M6430	UCS	K.2.1
Trehan	Indi		DC_M7367	UCS	K.2.1
Tremaine	Katie		DC_M6799	UCS	K.2.1
Tremper	Clare		DC_M7478	UCS	K.2.1
Tremper	Irene		DC_M6772	UCS	K.2.1
Trepes	Karen		DC_M6838	UCS	K.2.1
Trevino	Alicia		DC_M2269	UCS	K.2.1
Trewet	Claudia		DC_M2554	UCS	K.2.1
Tribble	Kassandra		DC_M0860	UCS	K.2.1
Trice	Richard		DC_M1594	UCS	K.2.1
Trigg	George		DC_M0324		K.2.1
Trinkala	Michael J.		DC_M5084	UCS	K.2.1
Trinkner	Clarence		DC_M6899	UCS	K.2.1
Trinkner	Clarence		DC_M6932	UCS	K.2.1
Trione	Edward		DC_M7233	UCS	K.2.1

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Trippe	Thomas		DC_M1698	UCS	K.2.1
Trouve	Annie		DC_M4246	UCS	K.2.1
Troyano	Paul		DC_M5920	UCS	K.2.1
Truax	Wayne		DC_M5884	UCS	K.2.1
Trufan	Hal		DC_M3857	UCS	K.2.1
Trujillo	Sharon R.		DC_M1940	UCS	K.2.1
Trull	Joe		DC_M5195	UCS	K.2.1
Trumbull	Erica		DC_M3186	UCS	K.2.1
Trumpp	Leon		DC_M2655	UCS	K.2.1
Trupp	Arthur		DC_M0695		K.2.1
Trupp	Arthur		DC_M4891	UCS	K.2.1
Trupp	Arthur		DC_M4892	UCS	K.2.1
Trupp	Arthur		DC_M6953	UCS	K.2.1
Trutna	Tiana		DC_M2351	UCS	K.2.1
Trycinski	Nancy		DC_M3222	UCS	K.2.1
Tsai	Michael		DC_M1722	UCS	K.2.1
Tsai	Micheal		DC_M3032	UCS	K.2.1
Tsang	Sauwah		DC_M6156	UCS	K.2.1
Tschersich	Hans		DC_M0731		K.2.1
Tseu	Maria E.		DC_M2835	UCS	K.2.1
Tsuchiguchi	Kahn		DC_M3405	UCS	K.2.1
Tu	Alexander		DC_M7428	UCS	K.2.1
Tucci	Harry		DC_M1885	UCS	K.2.1
Tuck	Edward		DC_M4214	UCS	K.2.1
Tucker	Emil J.		DC_M3621	UCS	K.2.1
Tucker	Judi		DC_M0803	UCS	K.2.1
Tucker	Julia		DC_M5673	UCS	K.2.1
Tucker	Robb		DC_M4182	UCS	K.2.1
Tuff	Paul David		DC_M5399	UCS	K.2.1
Tullius	Michael		DC_M5757	UCS	K.2.1
Tummler	Janis		DC_M5751	UCS	K.2.1
Tunick	Janet		DC_M0067		K.2.1
Tuori	Katri		DC_M0644		K.2.1
Turk	Ann		DC_M1945	UCS	K.2.1
Turk	Christine		DC_M3588	UCS	K.2.1
Turk	Lawrence		DC_E0009		K.2.2
Turley	Lynne		DC_M5793	UCS	K.2.1
Turner	Allan		DC_M7576	UCS	K.2.1
Turner	Dan		DC_M6167	UCS	K.2.1
Turner	Kathleen Kaeding		DC_M6713	UCS	K.2.1
Turner	Lorna		DC_M1420	UCS	K.2.1
Turner	Mary		DC_M2117	UCS	K.2.1
Turner	Michael		DC_M7378	UCS	K.2.1
Turner	Paul		DC_M6532	UCS	K.2.1
Turner	Rene		DC_M3633	UCS	K.2.1
Turner	Susan		DC_M1480	UCS	K.2.1
Turnoy	David		DC_M4396	UCS	K.2.1
Turnwald	Brian		DC_M7790		K.2.3
Tursi	Patricia		DC_M1542	UCS	K.2.1
Tursman	Susan		DC_M2505	UCS	K.2.1
Turtle	C.M.		DC_M6374	UCS	K.2.1
Tusinac	Michele		DC_M1747	UCS	K.2.1
Tutihasi	R-Laurraine		DC_M2341	UCS	K.2.1
Tuttle	Therese		DC_M0655		K.2.1
Tuttle	William		DC_M5522	UCS	K.2.1
Twaddell	Cheryl		DC_M2949	UCS	K.2.1
Twerdochlib	Orysia		DC_M0342		K.2.1
Twitchell	Terry		DC_M5298	UCS	K.2.1

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Twombly	Janneke		DC_M3997	UCS	K.2.1
Twombly	Martha		DC_M0812	UCS	K.2.1
Tyler	Tim		DC_M4198	UCS	K.2.1
Tylor	Ronaye		DC_M3847	UCS	K.2.1
Tynan	Kathleen		DC_M1733	UCS	K.2.1
Tyree	Kathleen		DC_M1402	UCS	K.2.1
Ude	Cherie		DC_E0398		K.3.2, K.3.3, K.3.6, K.3.7, K.3.12, K.3.15
Udin	David		DC_M7602	UCS	K.2.1
Uharriet	Sarah		DC_M3455	UCS	K.2.1
Uhrhane	Eric		DC_M6224	UCS	K.2.1
Ullrey	Virginia Booz		DC_M4211	UCS	K.2.1
Ulmer	Victor	Mrs. Victor Ulmer	DC_M5976	UCS	K.2.1
Underland-Rosow	Vicki		DC_M3796	UCS	K.2.1
Ungar	Jonathan		DC_M1134	UCS	K.2.1
Unlisted	Proflaura		DC_M3666	UCS	K.2.1
Unruh	Larry A.		DC_M5741	UCS	K.2.1
Unruh	Roy		DC_M1288	UCS	K.2.1
Upp	James		DC_M3156	UCS	K.2.1
Upper	Elizabeth		DC_M7358	UCS	K.2.1
Urb	Johann		DC_M3315	UCS	K.2.1
Urban	James		DC_M1081	UCS	K.2.1
Urionabarrenetxea	Pedro M		DC_M7064	UCS	K.2.1
Urrutia	Jack		DC_M3287	UCS	K.2.1
Uszak	Dennis		DC_M1177	UCS	K.2.1
Utley	William		DC_M2869	UCS	K.2.1
Utzig	Albert		DC_M5639	UCS	K.2.1
Uwanawich	Dorothy		DC_M5451	UCS	K.2.1
Vagi	Brian		DC_M2451	UCS	K.2.1
Vaidya	Bhavna		DC_M0727		K.2.1
Vajames	Carole		DC_M4307	UCS	K.2.1
Valdez	Samuel		DC_M3724	UCS	K.2.1
Valentine	Diana		DC_M7193	UCS	K.2.1
Valerie	Argenal		DC_M0330		K.2.1
Vallentine	Jo		DC_E0301	People for Nuclear Disarmament	K.3.1, K.3.2, K.3.3, K.3.4, K.3.5, K.3.10, K.3.11, K.3.12, K.3.13, K.3.15
Vallery	Earl		DC_M2461	UCS	K.2.1
Valles	Gene		DC_M6149	UCS	K.2.1
Valyou	Lauren		DC_M7505	UCS	K.2.1
van Beelen	Norm		DC_M7406	UCS	K.2.1
Van Dam	Julie		DC_M3970	UCS	K.2.1
van Davis	Barbara		DC_M2654	UCS	K.2.1
van Davis	Jeffrey		DC_M2650	UCS	K.2.1
Van de Werken	Paula		DC_M7385	UCS	K.2.1
Van den Pol	Gie		DC_M0288		K.3.14
Van der Horst	Mary Claire		DC_M6424	UCS	K.2.1
Van der Veen	Benjamin		DC_M5937	UCS	K.2.1
van Eyk	Diana		DC_M0862	UCS	K.2.1
Van Hart	Parker		DC_M1387	UCS	K.2.1
Van Horn	Dana		DC_M1744	UCS	K.2.1
Van Leunen	Alice		DC_M7417	UCS	K.2.1
Van Ness	Erin		DC_M0918	UCS	K.2.1
Van Schaick	Mary		DC_M6022	UCS	K.2.1
Van Schravendijk	Marie		DC_M5385	UCS	K.2.1
Van Wyck	Alison G.		DC_M4536	UCS	K.2.1
Vanasek	Melissa		DC_M2237	UCS	K.2.1
VanBrocklin	Jackie		DC_M0298		K.2.1
VanDame	Kathy		DC_M4515	UCS	K.2.1

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Vanderhoeven	Hetty		DC_M3473	UCS	K.2.1
Vanderleelie	Roy		DC_M4177	UCS	K.2.1
Vanderschaaf	Carol		DC_M6204	UCS	K.2.1
VanHorn-Bostwick	Erica		DC_M5744	UCS	K.2.1
VanHorne	Mark		DC_M5506	UCS	K.2.1
VanHouten	Eva		DC_M6969	UCS	K.2.1
VanTil	Evelyn		DC_M5617	UCS	K.2.1
VanTil	Evelyn		DC_M5620	UCS	K.2.1
VanValkinburgh	Liz		DC_M1269	UCS	K.2.1
Vapenik	Gene		DC_M0696		K.2.1
Varian	Linda		DC_M7375	UCS	K.2.1
Varjavand	Nahid		DC_M0642		K.2.1
Vars	Jacqueline		DC_M4228	UCS	K.2.1
Vasquez	Suzanna		DC_M4486	UCS	K.2.1
Vassilakidis	Marie Sophia		DC_M1258	UCS	K.2.1
Vassos	Angelo		DC_M3735	UCS	K.2.1
Vatcher	Dorothy		DC_M0450		K.2.1
Vaten	Sharon		DC_M1916	UCS	K.2.1
Vaughan	Karen		DC_M0755		K.2.1
Vaughn	James		DC_M0993	UCS	K.2.1
Vaughn	Keith		DC_M7376	UCS	K.2.1
Vaughn	Viki		DC_M1958	UCS	K.2.1
Vaught	Ronald		DC_M1736	UCS	K.2.1
Vayssieres	Marc		DC_M3091	UCS	K.2.1
Veach	Margaret		DC_M1768	UCS	K.2.1
Vedder	Barbara		DC_M3727	UCS	K.2.1
Vega	Selene		DC_M7476	UCS	K.2.1
Veiga	Linda		DC_M5596	UCS	K.2.1
Veirs	Scott		DC_M7707		K.2.1
Veith	Kenneth Warren		DC_M3611	UCS	K.2.1
Velev	Omourtag		DC_M0671		K.2.1
Veltfort	Leonore		DC_M0240	Women's International League for Peace and Freedom, United States Section	K.3.12, K.3.15
Veltri	Carlo		DC_M1313	UCS	K.2.1
Venema	Eve		DC_M4915	UCS	K.2.1
Venus	Pamela		DC_M7495	UCS	K.2.1
Veon	Mike		DC_M6654	UCS	K.2.1
Veras	Edward		DC_M3456	UCS	K.2.1
Verber	Jean	Judene Walsh, Rosalie Lauer	DC_E0378		K.3.2, K.3.3, K.3.7, K.3.11, K.3.12, K.3.15
Verchinski	Stephen		DC_M5771	UCS	K.2.1
Verdier	Bill		DC_M5502	UCS	K.2.1
Vergara	Julia		DC_M6293	UCS	K.2.1
Vermillion	Julianna		DC_M3653	UCS	K.2.1
Vern	Jane		DC_M6042	UCS	K.2.1
Veronelli	Vrobert		DC_M3040	UCS	K.2.1
Verrengia	A		DC_E0051		K.2.2
Verrill	Evelyn		DC_M5420	UCS	K.2.1
Vertrees	Gerald		DC_M3863	UCS	K.2.1
Vesely	Jane		DC_M7017	UCS	K.2.1
Vetter	Andrew		DC_M5568	UCS	K.2.1
Vice	Daniel		DC_M2675	UCS	K.2.1
Victor	Arisa		DC_M6407	UCS	K.2.1
Viehmann	Laura		DC_M4960	UCS	K.2.1
Vieira	David T.		DC_M6580	UCS	K.2.1

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Vierthaler	Cathy		DC_M4835	UCS	K.2.1
Viglia	Peter		DC_M5824	UCS	K.2.1
Viglia	Peter A.		DC_M6894	UCS	K.2.1
Viglietta	Keith		DC_M7387	UCS	K.2.1
Viken	Barbara		DC_M7157	UCS	K.2.1
Vilano	Patrick		DC_M5760	UCS	K.2.1
Villavicencio	Ricardo		DC_M1393	UCS	K.2.1
Villavicencio	Ricardo		DC_M4167	UCS	K.2.1
Villavicencio	Ricardo		DC_M6247	UCS	K.2.1
Viltoria	Kiss		DC_M2959	UCS	K.2.1
Vincent	Sarah		DC_M0889	UCS	K.2.1
Vines	Sarah		DC_M4815	UCS	K.2.1
Vinick	Martha		DC_M6666	UCS	K.2.1
Vinick	Martha Osborn		DC_E0322		K.3.2, K.3.3, K.3.4, K.3.6, K.3.11, K.3.12, K.3.13
Vining	Stewart		DC_M2286	UCS	K.2.1
Vinson	John		DC_M4272	UCS	K.2.1
Virgil	Philip		DC_M5405	UCS	K.2.1
Visakowitz	Susan		DC_M4714	UCS	K.2.1
Visci	Gina		DC_M6851	UCS	K.2.1
Visher	Elizabeth		DC_M0739		K.2.1
Vitale	Elizabeth		DC_M4621	UCS	K.2.1
Viveiros	George		DC_M3953	UCS	K.2.1
Vivian	Connolly		DC_M2518	UCS	K.2.1
Vogel	Nathan		DC_M5485	UCS	K.2.1
Vogel	Nathan		DC_M6885	UCS	K.2.1
Vogel	Suzanne		DC_M4735	UCS	K.2.1
Vogele	John		DC_M5766	UCS	K.2.1
Vogt	Rainbow		DC_M0516		K.2.1
Voight	Mary C.		DC_M6709	UCS	K.2.1
Volckhausen	David		DC_M4255	UCS	K.2.1
Volk	Karl		DC_M3201	UCS	K.2.1
Volkmer	Miriam A.		DC_M4751	UCS	K.2.1
Volling	Kathleen		DC_M3702	UCS	K.2.1
Volmensky	Vitaly		DC_M2994	UCS	K.2.1
Volodka	Algirdas		DC_M6658	UCS	K.2.1
Volpp	Kevin		DC_M6332	UCS	K.2.1
von Giebel	Robert G		DC_M2454	UCS	K.2.1
Von Lossberg	Ann		DC_M0921	UCS	K.2.1
von Platen	Brigitte		DC_M3874	UCS	K.2.1
von Schonfeld	Walter		DC_M2234	UCS	K.2.1
von Wendt	Katherine		DC_M5432	UCS	K.2.1
Vonn	Monty		DC_M5186	UCS	K.2.1
Vontilla	Steven		DC_M3153	UCS	K.2.1
Voorhies	Bill	Marilyn Voorhies	DC_M0187		K.3.14
Voorhies	Marylin	Bill Voorhies	DC_M5838	UCS	K.2.1
Voss	Barbara		DC_M7628	UCS	K.2.1
Voss	Barbara		DC_M7629	UCS	K.2.1
Voss	Betty		DC_E0263		K.2.2
Voss	Erika M.		DC_M5594	UCS	K.2.1
Vrecenak	Joanne		DC_M7026	UCS	K.2.1
Vredenburg	Vance		DC_M0817	UCS	K.2.1
Vuong	Ilene		DC_M5943	UCS	K.2.1
W	E		DC_M7814		K.2.1
W	Michelle		DC_M3471	UCS	K.2.1
W.	Rachel		DC_M0559		K.2.1
Wachowiak	Paul		DC_M3087	UCS	K.2.1
Wachsberger	Fredrica		DC_M4628	UCS	K.2.1
Waddell	Michael		DC_E0130		K.2.3

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Waddle	Lottie		DC_M7643	UCS	K.2.1
Wade	Andrea		DC_M1244	UCS	K.2.1
Wade	Jodi		DC_M7126	UCS	K.2.1
Wade	Lillian		DC_M3657	UCS	K.2.1
Wagener	Ben		DC_M1330	UCS	K.2.1
Wager	Ray		DC_M5336	UCS	K.2.1
Wager	Ray		DC_M7916		K.2.3
Wagner	Carol C.		DC_M7393	UCS	K.2.1
Wagner	Dr. GB		DC_M1932	UCS	K.2.1
Wagner	Elissa		DC_M3520	UCS	K.2.1
Wagner	James		DC_M1003	UCS	K.2.1
Wagner	John		DC_M2622	UCS	K.2.1
Wagner	Jon		DC_M7872		K.2.1
Wagner	Laurie		DC_M3811	UCS	K.2.1
Wagner	Linda		DC_M5648	UCS	K.2.1
Wagner	Lloyd		DC_M1825	UCS	K.2.1
Wagner	Melissa		DC_M1836	UCS	K.2.1
Wagner	Sandra		DC_M2378	UCS	K.2.1
Wahl	Emily		DC_M6155	UCS	K.2.1
Wahl	Jennifer		DC_M0400		K.2.1
Wahl	Richard		DC_M6387	UCS	K.2.1
Wahosi	Mare		DC_M6066	UCS	K.2.1
Waine	Linda		DC_M7508	UCS	K.2.1
Walden	Jeanette		DC_M1223	UCS	K.2.1
Walden	Jeanette		DC_M5424	UCS	K.2.1
Waldrip	William Mack		DC_M7067	UCS	K.2.1
Waldron	Laurie		DC_M4275	UCS	K.2.1
Waldron	Robert		DC_M5977	UCS	K.2.1
Wales	Christopher		DC_M7135	UCS	K.2.1
Walker	Augustus		DC_M6983	UCS	K.2.1
Walker	Birgit		DC_M1798	UCS	K.2.1
Walker	Dale		DC_M7153	UCS	K.2.1
Walker	Emily		DC_M1078	UCS	K.2.1
Walker	Graham		DC_M0081		K.2.1
Walker	John C		DC_M3095	UCS	K.2.1
Walker	Kay		DC_M6238	UCS	K.2.1
Walker	Lynn		DC_M6973	UCS	K.2.1
Walker	Matthew		DC_M0483		K.2.1
Walker	Michelle		DC_M2524	UCS	K.2.1
Walker	Raelene		DC_M3139	UCS	K.2.1
Walker	Thomas		DC_M0667		K.2.1
Walker	Todd		DC_M6021	UCS	K.2.1
Walker	Todd		DC_M6439	UCS	K.2.1
Wall	Carol S.		DC_M6573	UCS	K.2.1
Wall	Elizabeth		DC_M0687		K.2.1
Wall	Nancy		DC_M5649	UCS	K.2.1
Wall	Sheila		DC_M6759	UCS	K.2.1
Wall	Elizabeth		DC_M5873	UCS	K.2.1
Wall	Nancy		DC_M6948	UCS	K.2.1
Wallace	Gerald		DC_M1232	UCS	K.2.1
Wallace	Jenise		DC_M6937	UCS	K.2.1
Wallace	Kay		DC_M5408	UCS	K.2.1
Wallace	Nathan		DC_M4107	UCS	K.2.1
Wallander	Carl		DC_M6644	UCS	K.2.1
Waller	Carolyn		DC_M5828	UCS	K.2.1
Waller	Joan	Paul Waller	DC_M7588	UCS	K.2.1
Walrafen	Barbara		DC_M6541	UCS	K.2.1
Walsh	Ditra		DC_M2538	UCS	K.2.1
Walsh	Jane		DC_M4118	UCS	K.2.1

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Walsh	Terri		DC_M4061	UCS	K.2.1
Walter	Perianne		DC_M2309	UCS	K.2.1
Walter	William		DC_M0843	UCS	K.2.1
Waltermire	Virginia		DC_M5051	UCS	K.2.1
Wang	Harry		DC_E0418	PSR- Sacramento	K.3.3, K.3.4, K.3.5, K.3.11, K.3.13, K.3.15
Wang	Harry		DC_PHO0036	Physicians for Social Responsibility Sacramento, Physicians for 24 Social Responsibility	K.3.1, K.3.2, K.3.3, K.3.4, K.3.13, K.3.15
Wang	T.K.		DC_M5572	UCS	K.2.1
Wantanabe	Astrid		DC_M6829	UCS	K.2.1
Wanzer	Sidney		DC_M0141		K.3.2, K.3.14
Ward	Dennis		DC_M2870	UCS	K.2.1
Ward	Everett		DC_M2517	UCS	K.2.1
Ward	Faye		DC_M1769	UCS	K.2.1
Ward	Fred		DC_M0149		K.2.1
Ward	Greg		DC_E0180		K.3.2, K.3.13, K.3.14
Ward	Melanie		DC_M6275	UCS	K.2.1
Ward	Melanie		DC_M6277	UCS	K.2.1
Ward	Pamela		DC_M4987	UCS	K.2.1
Warden	Suzanne		DC_M3116	UCS	K.2.1
Ware	S.B.		DC_M4400	UCS	K.2.1
Waring	Robert		DC_M3030	UCS	K.2.1
Wark	Thomas E.		DC_M5419	UCS	K.2.1
Warner	Darryl		DC_E0295		K.2.3
Warner	Horace		DC_M5444	UCS	K.2.1
Warner	John		DC_M4433	UCS	K.2.1
Warner	Keith		DC_M0305		K.2.1
Warner	Peter		DC_M4012	UCS	K.2.1
Warner	Robert		DC_M7893		K.2.1
Warpehoski	Martha		DC_M4173	UCS	K.2.1
Warren	Christopher		DC_M3876	UCS	K.2.1
Warren	Ellen C.		DC_M6152	UCS	K.2.1
Warren	Jan		DC_M6784	UCS	K.2.1
Warren	John		DC_M5755	UCS	K.2.1
Warren	Lee		DC_M2830	UCS	K.2.1
Warren	Naomi		DC_M6607	UCS	K.2.1
Warren	Phyllis		DC_M2864	UCS	K.2.1
Warren	Roxanne		DC_M4982	UCS	K.2.1
Warren	Tiffany		DC_M6997	UCS	K.2.1
Warren	Viola		DC_M3334	UCS	K.2.1
Warschau	M.B.		DC_M2294	UCS	K.2.1
Wasamuth	Carol Ann	Imagene Warren, Connie Sonnen, Joan Smith, Meg Sass, Wilma Schlangen, Agnes Reichlin, Valine Kachelmier, Mildred Lustig, Bernie Ternes, A. Oakley, Cecile Uhlorn, Carm Ternes, Angela Uhlorn, Sylveria Heiand, Mercedes Martzen, Judith Brown	DC_M0069	Monastary of St. Gertrude	K.2.1
Wasfi	Dahlia		DC_E0026		K.3.12
Wasfi	Dahlia		DC_M1757	UCS	K.2.1
Wash	Thomas		DC_M0036		K.2.1

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Washburn	Liz		DC_M1677	UCS	K.2.1
Washburn	Mark		DC_M2135	UCS	K.2.1
Wasser	Sarah		DC_M3622	UCS	K.2.1
Wassmuth	Carol Ann		DC_M4454	UCS	K.2.1
Waters	Patricia		DC_M3393	UCS	K.2.1
Waters	Shaun		DC_M0216		K.2.1
Watkins	Walter		DC_M2971	UCS	K.2.1
Watlington	Elton		DC_M7041	UCS	K.2.1
Watson	Angela		DC_M4267	UCS	K.2.1
Watson	Claire		DC_M6199	UCS	K.2.1
Watson	Jeff		DC_M3143	UCS	K.2.1
Watson	Sharon		DC_M0332		K.2.1
Watson	Warren		DC_M3498	UCS	K.2.1
Watt	J		DC_M4804	UCS	K.2.1
Watts	Elizabeth		DC_M0241		K.3.2, K.3.10, K.3.14
Watts	George		DC_M1717	UCS	K.2.1
Watts	Sarah		DC_M6354	UCS	K.2.1
Watts Jr	Weston A		DC_M2468	UCS	K.2.1
Waud	John		DC_M1875	UCS	K.2.1
Waugh	Marianne R.		DC_M4375	UCS	K.2.1
Waugh	Michael		DC_M0811	UCS	K.2.1
Wawrzyniak	Chad		DC_M2338	UCS	K.2.1
Wdowiak	David		DC_M5300	UCS	K.2.1
Weaver	Anne		DC_M2369	UCS	K.2.1
Weaver	Cheryl		DC_M5636	UCS	K.2.1
Weaver	Joe		DC_M2198	UCS	K.2.1
Weaver	Julene		DC_M7631	UCS	K.2.1
Webb	Gene		DC_M1379	UCS	K.2.1
Webb	H. Chandler		DC_M5667	UCS	K.2.1
Webb	John		DC_M1933	UCS	K.2.1
Webb	Mary Theresa		DC_E0116		K.3.14
Webb	Sheff		DC_M1298	UCS	K.2.1
Webber	Carroll		DC_E0007		K.3.2, K.3.4, K.3.10, K.3.11
Webber	Carroll		DC_E0221		K.3.2, K.3.11
Webber	Rita		DC_M3200	UCS	K.2.1
Weber	Kenneth		DC_M6739	UCS	K.2.1
Webster	Earlene		DC_M6346	UCS	K.2.1
Web-Walker	Tina		DC_M3171	UCS	K.2.1
Weggel	Robert		DC_M7811		K.2.1
Wehrer	Laurie		DC_M7553	UCS	K.2.1
Wehrle	Leroy S.		DC_M2048	UCS	K.2.1
Wehrli-Hemmeter	Ginny		DC_M5697	UCS	K.2.1
Weibel	Annemarie		DC_M6266	UCS	K.2.1
Weibert	Gary		DC_M3932	UCS	K.2.1
Weidner	Naomi		DC_M2329	UCS	K.2.1
Weiermann	Daniel		DC_M3844	UCS	K.2.1
Weigand	Christine		DC_M1641	UCS	K.2.1
Weigle	Elizabeth		DC_M2210	UCS	K.2.1
Weigner	Steven		DC_M0297	UCS	K.2.1
Weikal	William Byron		DC_M0198		K.2.1
Weiland	Alex		DC_M2204	UCS	K.2.1
Weiland	Sherry		DC_M4951	UCS	K.2.1
Weilenmann	Alex		DC_M3268	UCS	K.2.1
Weinberg	Louis		DC_M5023	UCS	K.2.1
Weiner	Lori		DC_M1005	UCS	K.2.1
Weininschke	Deborah		DC_M5480	UCS	K.2.1
Weinstein	David		DC_M7759		K.2.1
Weishaar	Jennifer M.		DC_M4637	UCS	K.2.1
Weiss	Ann		DC_M2307	UCS	K.2.1

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Weiss	Arleen		DC_M1479	UCS	K.2.1
Weiss	Benjamin L.		DC_M6758	UCS	K.2.1
Weiss	Dorthy		DC_M0023		K.3.7, K.3.11, K.3.12
Weiss	Ira		DC_M1114	UCS	K.2.1
Weiss	Judy		DC_M3476	UCS	K.2.1
Weiss	Marc		DC_M2592	UCS	K.2.1
Weisskirk	Lynne		DC_M0846	UCS	K.2.1
Weitkamp	Robert		DC_M5925	UCS	K.2.1
Weitzmann	Margaret		DC_E0300		K.3.2, K.3.3, K.3.11, K.3.12, K.3.13
Welch	Annette		DC_M7632	UCS	K.2.1
Welch	Sheila		DC_M2120	UCS	K.2.1
Welch	Tim		DC_M2631	UCS	K.2.1
Weldon	Laura		DC_M7025	UCS	K.2.1
Welford	Gabrielle		DC_M5602	UCS	K.2.1
Weller	Jacqueline		DC_M6210	UCS	K.2.1
Welles	Skip		DC_M2907	UCS	K.2.1
Wells	Jason		DC_M7191	UCS	K.2.1
Wells	Jennifer		DC_M4335	UCS	K.2.1
Wells	Jordan		DC_E0036		K.3.1, K.3.3, K.3.7, K.3.11, K.3.12
Wells	William		DC_M5375	UCS	K.2.1
Welsh	Larry		DC_M5108	UCS	K.2.1
Welter	Richard		DC_M3871	UCS	K.2.1
Wen	Frederick		DC_M4109	UCS	K.2.1
Wendel	Tara		DC_M7342	UCS	K.2.1
Wendt	Diana		DC_M1038	UCS	K.2.1
Wendt	Erin		DC_M4405	UCS	K.2.1
Wenner	Shirley L.		DC_M4088	UCS	K.2.1
Wentz	Candice		DC_E0066		K.3.1, K.2.2, K.3.3, K.3.7, K.3.11, K.3.15
Werner	Miriam		DC_M4499	UCS	K.2.1
Werner	Walter		DC_M5503	UCS	K.2.1
Wert	Dorean		DC_M6910	UCS	K.2.1
Werth	J.		DC_M4358	UCS	K.2.1
Werzinski	Joseph		DC_M2061	UCS	K.2.1
Wessbecher	Marlies		DC_M1968	UCS	K.2.1
Wessels	Rose		DC_M6360	UCS	K.2.1
Wessling	Nan		DC_M1503	UCS	K.2.1
West	John		DC_M5889	UCS	K.2.1
West	John		DC_M5891	UCS	K.2.1
West	Kathleen and Hans		DC_M3198	UCS	K.2.1
West	Mary		DC_E0230		K.3.2, K.3.3, K.3.7, K.3.11, K.3.15
West	Mary		DC_E0231		K.4
Westhafer	John		DC_M6566	UCS	K.2.1
Westman	Lisa		DC_M6440	UCS	K.2.1
Weston	Hugh		DC_M2196	UCS	K.2.1
Weston	Maria		DC_M0399		K.2.1
Westrate	Bea		DC_M2868	UCS	K.2.1
Whalen	Michael		DC_M7687		K.2.1
Whaley	Lorraine		DC_M0223		K.3.2, K.3.3, K.3.7, K.3.12, K.3.15
Wheeler	Breana		DC_M6154	UCS	K.2.1
Wheeler	Carolyn		DC_M2670	UCS	K.2.1
Wheeler	John		DC_M7864		K.2.1
Wheeler	Judith	Michael Wheeler	DC_M7444	UCS	K.2.1
Wheeler	Romona		DC_M1422	UCS	K.2.1

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Wheelock	Michael		DC_M5742	UCS	K.2.1
Whelan	Joseph		DC_E0209		K.3.3, K.3.12
Whipple	Wyman		DC_M6492	UCS	K.2.1
Whitacre	Donnella		DC_M4224	UCS	K.2.1
Whitbeck	Monte		DC_M2068	UCS	K.2.1
Whitcomb	Sarah-Elizabeth		DC_M1997	UCS	K.2.1
White	Cheryl		DC_M2276	UCS	K.2.1
White	Dave		DC_M4655	UCS	K.2.1
White	Eric		DC_M3509	UCS	K.2.1
White	Felice		DC_M5664	UCS	K.2.1
White	Galen		DC_E0228		K.2.2
White	Jane		DC_M2449	UCS	K.2.1
White	Jeffrey		DC_M3820	UCS	K.2.1
White	John		DC_M1615	UCS	K.2.1
White	Kathleen		DC_M0931	UCS	K.2.1
White	Lois		DC_M0448		K.2.1
White	Lois		DC_M3151	UCS	K.2.1
White	Marianne		DC_M6330	UCS	K.2.1
White	Rodney		DC_M4905	UCS	K.2.1
White	Sharlene		DC_M1595	UCS	K.2.1
White	Veda		DC_M3898	UCS	K.2.1
White	William		DC_M3279	UCS	K.2.1
White	William H.		DC_M4071	UCS	K.2.1
White	Steven		DC_M3352	UCS	K.2.1
White/Covey	Jean/George		DC_M2393	UCS	K.2.1
Whitecar	Deborah		DC_M1396	UCS	K.2.1
Whitehead	Betsy		DC_M3913	UCS	K.2.1
Whitehead	Rebecca R.		DC_M7364	UCS	K.2.1
Whitehead	Richard		DC_M4959	UCS	K.2.1
Whiteley	Emily C.		DC_M2941	UCS	K.2.1
Whitelock	Linda Lee		DC_M4309	UCS	K.2.1
Whitmont	Andrew		DC_M3345	UCS	K.2.1
Whitmore	Karen		DC_M0734		K.2.1
Whitmore	Ron		DC_M6340	UCS	K.2.1
Whitney	Diane		DC_M7241	UCS	K.2.1
Whittingham	Anne		DC_E0426		K.3.5, K.3.7, K.3.11, K.3.12, K.3.15
Whittington	Dana Thomas		DC_M2513	UCS	K.2.1
Wiatrowski	Sandra		DC_M5601	UCS	K.2.1
Wible	Karen		DC_M1466	UCS	K.2.1
Wick	Therese		DC_M5493	UCS	K.2.1
Wickersham	Laura		DC_M7127	UCS	K.2.1
Wicks	Nancy		DC_M5166	UCS	K.2.1
Wieland	A.H.		DC_M0706		K.2.1
Wieland	Molly		DC_M4388	UCS	K.2.1
Wiese	Ellen		DC_M6391	UCS	K.2.1
Wiese	Jennie		DC_M1883	UCS	K.2.1
Wiget	Francis		DC_M4672	UCS	K.2.1
Wiggers	Stewart		DC_M0663		K.2.1
Wiggers	Stewart		DC_M2786	UCS	K.2.1
Wiggins	Terry		DC_M6191	UCS	K.2.1
Wiggs	Steve		DC_M2974	UCS	K.2.1
Wight	Nelson		DC_M7353	UCS	K.2.1
Wightman	Jean		DC_M0197		K.2.1
Wilcox	Jill		DC_M6220	UCS	K.2.1
Wilcox	Linda		DC_M1802	UCS	K.2.1
Wilcox	Linda		DC_M1809	UCS	K.2.1
Wilcox	Molly		DC_E0102		K.2.2
Wilder	James P.		DC_M3647	UCS	K.2.1

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Wildern	Nancy		DC_M0021		K.3.12, K.3.13
Wildt	Ron		DC_M2172	UCS	K.2.1
Wiley	Michael R.		DC_M7259	UCS	K.2.1
Wilhelm	Janus		DC_M4736	UCS	K.2.1
Wilhelmi	Christy		DC_M1356	UCS	K.2.1
Wilkins	Erin		DC_M5181	UCS	K.2.1
Wilkins	Nilufer		DC_E0115		K.2.3
Wilkins	Paul		DC_M6065	UCS	K.2.1
Wilkinson	R. Allen		DC_M4517	UCS	K.2.1
Will	John		DC_M1566	UCS	K.2.1
Willams	Mark		DC_E0131		K.2.3
Willemsen	Micahel		DC_E0088	Revrend	K.2.2
Willey	Monique		DC_M2121	UCS	K.2.1
Willey	Paula		DC_M0265		K.3.2, K.3.3, K.3.15
Williams	Craig		DC_E0128		K.2.3
Williams	Cyndy		DC_M5441	UCS	K.2.1
Williams	David		DC_E0093		K.3.3, K.3.7
Williams	Diane M		DC_M2148	UCS	K.2.1
Williams	Elaine		DC_M0984	UCS	K.2.1
Williams	Elizabeth		DC_M1894	UCS	K.2.1
Williams	Garth		DC_M0363		K.2.1
Williams	Givhan		DC_M1203	UCS	K.2.1
Williams	Janet		DC_M3415	UCS	K.2.1
Williams	John		DC_M5242	UCS	K.2.1
Williams	Kelli		DC_M3002	UCS	K.2.1
Williams	Laurie		DC_M7281	UCS	K.2.1
Williams	Lora Marie		DC_M2229	UCS	K.2.1
Williams	Lynda		DC_E0394		K.2.2
Williams	Lynda		DC_M6693	UCS	K.2.1
Williams	Lynne		DC_M3053	UCS	K.2.1
Williams	Marilyn		DC_M0603		K.2.1
Williams	Mark		DC_E0377		K.2.3
Williams	Matthew		DC_M1020	UCS	K.2.1
Williams	Natasha		DC_M3800	UCS	K.2.1
Williams	P.		DC_M0188		K.3.1, K.3.2
Williams	Paul	Lynde Williams	DC_M6662	UCS	K.2.1
Williams	Sarah		DC_M1499	UCS	K.2.1
Williams	Seanna		DC_M4734	UCS	K.2.1
Williams	Stephen		DC_M3217	UCS	K.2.1
Williams	Stephen		DC_M4530	UCS	K.2.1
Williams	Terese		DC_M4709	UCS	K.2.1
Williams	Ursula		DC_M6159	UCS	K.2.1
Williams	Wayne		DC_M3515	UCS	K.2.1
Williams	Wyatt		DC_M3421	UCS	K.2.1
Williams-Chase	Jean		DC_M0651		K.2.1
Williamson	J.C.		DC_M3242	UCS	K.2.1
Williamson	Joan		DC_M0055		K.2.1
Williamson	Peter		DC_M7244	UCS	K.2.1
Williamson	Sandra		DC_M3180	UCS	K.2.1
Willing	Rick		DC_M0714		K.2.1
Willis	Christine		DC_M6697	UCS	K.2.1
Willis	Kristen		DC_M7275	UCS	K.2.1
Willis	Mary		DC_M5903	UCS	K.2.1
Willman	Rachel		DC_M1352	UCS	K.2.1
Willmott	Marian		DC_M7484	UCS	K.2.1
Willour	Judith		DC_M3718	UCS	K.2.1
Wills	Kathy		DC_M6702	UCS	K.2.1
Wills	Sherry		DC_M0024		K.2.2
Wilner	Lawrence		DC_M0194		K.3.14

Last Name	First Name	Additional Commenters	Comment Document Number	Commenter Organization	Subsection Where Comment is Addressed
Wilson	CR		DC_M2109	UCS	K.2.1
Wilson	Eric		DC_M0452		K.2.1
Wilson	Erica		DC_M2398	UCS	K.2.1
Wilson	Faustine		DC_M6080	UCS	K.2.1
Wilson	Gaye		DC_M7028	UCS	K.2.1
Wilson	Heather		DC_M6227	UCS	K.2.1
Wilson	Jan		DC_M1326	UCS	K.2.1
Wilson	Jane		DC_M3446	UCS	K.2.1
Wilson	Jeff		DC_M6570	UCS	K.2.1
Wilson	Jerry		DC_M5303	UCS	K.2.1
Wilson	Jim		DC_M6682	UCS	K.2.1
Wilson	Kay		DC_M1063	UCS	K.2.1
Wilson	Lynn		DC_M7671	UCS	K.2.1
Wilson	Olive		DC_M0617		K.2.1
Wilson	Phillip		DC_M4825	UCS	K.2.1
Wilson	Phillip		DC_M4997	UCS	K.2.1
Wilson	Robert		DC_M6788	UCS	K.2.1
Wilson	Scott		DC_M7037	UCS	K.2.1
Wilson	Shana		DC_M7100	UCS	K.2.1
Wilson	Susan E.		DC_M5140	UCS	K.2.1
Wilson	Todd		DC_M3470	UCS	K.2.1
Wimbrow	Betsy		DC_M3475	UCS	K.2.1
Wine	Deborah		DC_M5647	UCS	K.2.1
Winer	Diana		DC_M5629	UCS	K.2.1
Wingeier	Douglas		DC_M4406	UCS	K.2.1
Winig	Guy		DC_M2395	UCS	K.2.1
Winkler	Renate		DC_M6324	UCS	K.2.1
Winnette	Julie		DC_M5890	UCS	K.2.1
Winslett	Paige		DC_M5916	UCS	K.2.1
Winter	Sandra		DC_M4495	UCS	K.2.1
Winterer	Jorg		DC_M5063	UCS	K.2.1
Wiorek	Mona		DC_M6450	UCS	K.2.1
Wischmann	Lesley		DC_M2720	UCS	K.2.1
Wise	Chad		DC_M5963	UCS	K.2.1
Wishingrad	Barbara		DC_M5727	UCS	K.2.1
Wisialowski	Bart		DC_M2932	UCS	K.2.1
Wisniewski	Gail		DC_M0468		K.2.1
Witback	Carol		DC_M5696	UCS	K.2.1
Witt	Brody		DC_M2750	UCS	K.2.1
Wittel	Lauren		DC_M5623	UCS	K.2.1
Wlodarek	Desiree		DC_M6877	UCS	K.2.1
Wodjenski	Joseph		DC_M1537	UCS	K.2.1
Woffard	William		DC_M6467	UCS	K.2.1
Wojciechowski	Stanley		DC_M2101	UCS	K.2.1
Wojkowski	Mary		DC_M7904		K.2.1
Woletz	Amanda		DC_M3575	UCS	K.2.1
Wolf	Diane		DC_E0044		K.3.1, K.3.11, K.3.12, K.3.15
Wolf	Lisa		DC_M7018	UCS	K.2.1
Wolf	Marty		DC_M5079	UCS	K.2.1
Wolf	Maxine Diane		DC_M0132		K.2.1
Wolf	Patty		DC_M1942	UCS	K.2.1
Wolf	Pauline		DC_M6297	UCS	K.2.1
Wolf	Susan		DC_M4888	UCS	K.2.1
Wolf	Sylvia	Leo Wolf	DC_M0142		K.2.1
Wolfe	Dolores		DC_M5156	UCS	K.2.1
Wolfe	John		DC_M2741	UCS	K.2.1
Wolfe	Judith		DC_M6569	UCS	K.2.1
Wolff	Daynna		DC_M5491	UCS	K.2.1
Wolff	Jean		DC_M2541	UCS	K.2.1

Last Name	First Name	Additional Commenters	Comment Document Number	Commenter Organization	Subsection Where Comment is Addressed
Wolin	Jessica		DC_M7388	UCS	K.2.1
Woller	W.J.		DC_M5129	UCS	K.2.1
Woller	W.J.		DC_M5685	UCS	K.2.1
Wolters	Marilyn		DC_M7311	UCS	K.2.1
Wolters	Melvin		DC_M3887	UCS	K.2.1
Womble	Jeffrey Earl		DC_M6917	UCS	K.2.1
Wong	Teresa		DC_M6480	UCS	K.2.1
Wong	Teresa		DC_M6484	UCS	K.2.1
Woo	Howard		DC_M3815	UCS	K.2.1
Wood	Amanda		DC_M1801	UCS	K.2.1
Wood	Dayna		DC_M2228	UCS	K.2.1
Wood	Donald W.		DC_M6708	UCS	K.2.1
Wood	Jeremy		DC_M3606	UCS	K.2.1
Wood	Susan		DC_M3068	UCS	K.2.1
Woodard	Sarah F.		DC_M6750	UCS	K.2.1
Woodbury	Chad		DC_M6211	UCS	K.2.1
Woodbury	Mitchell		DC_M3249	UCS	K.2.1
Woodcock	Angela		DC_M6873	UCS	K.2.1
Woodfin	Jim		DC_M6358	UCS	K.2.1
Woodford	J.A.T.		DC_M3039	UCS	K.2.1
Woodhead	Nathaniel		DC_M5881	UCS	K.2.1
Woodruff	Cate		DC_M3688	UCS	K.2.1
Woods	Karla		DC_M7310	UCS	K.2.1
Woods	Linda L.		DC_M5600	UCS	K.2.1
Woods	Mark		DC_M1721	UCS	K.2.1
Woods	Terry		DC_M5447	UCS	K.2.1
Woods	James		DC_M4551	UCS	K.2.1
Woodside	Don		DC_E0268		K.2.2
Woodson	Kellie		DC_M3511	UCS	K.2.1
Woodson	Shaun		DC_M0492		K.2.1
Woodson	Shaun		DC_M4353	UCS	K.2.1
Woolwine	Mark		DC_M1085	UCS	K.2.1
Wooten	Sandra P		DC_M2703	UCS	K.2.1
Wootton	John		DC_M2107	UCS	K.2.1
Worden	Donna		DC_M5088	UCS	K.2.1
Worden	Jessica		DC_M0124		K.2.1
Worley	Janice		DC_M1446	UCS	K.2.1
Worthington	Lynne		DC_M2764	UCS	K.2.1
Woweries	Moni		DC_M7180	UCS	K.2.1
Wozinak	Susan		DC_M5878	UCS	K.2.1
Wozna	Robert E.		DC_M1278	UCS	K.2.1
Wright	Alan		DC_M5996	UCS	K.2.1
Wright	Christine		DC_M3639	UCS	K.2.1
Wright	David		DC_M1787	UCS	K.2.1
Wright	Eileen		DC_M7463	UCS	K.2.1
Wright	Jacob		DC_M0493		K.2.1
Wright	Janet		DC_M6060	UCS	K.2.1
Wright	Mark		DC_M7667	UCS	K.2.1
Wright	Max		DC_M5416	UCS	K.2.1
Wright	Meredith		DC_M7527	UCS	K.2.1
Wright	Michael		DC_M0049		K.2.1
Wright	Patricia		DC_M5440	UCS	K.2.1
Wright	Patti		DC_E0272		K.2.2
Wright	Ricky		DC_M7036	UCS	K.2.1
Wright	Timothy		DC_M7869		K.3.1, K.3.3, K.3.11, K.3.13
Wright-Kaiser	Carol		DC_M0912	UCS	K.2.1
Wrona	Dorothy		DC_M4464	UCS	K.2.1
Wrzesien	Sheetal		DC_M1483	UCS	K.2.1
Wrzesien	Sheetal		DC_M1484	UCS	K.2.1

Last Name	First Name	Additional Commenters	Comment Document Number	Commenter Organization	Subsection Where Comment is Addressed
Wu	Sara		DC_M5843	UCS	K.2.1
Wyatt	Dorothy		DC_M4436	UCS	K.2.1
Wyatt	Margaret		DC_M3905	UCS	K.2.1
Wyatt	Margaret		DC_M3916	UCS	K.2.1
Wyatt	Maria		DC_M3333	UCS	K.2.1
Wyatt	Victoria		DC_M4448	UCS	K.2.1
Wychorski	Steven		DC_M1947	UCS	K.2.1
Wylie	Michael		DC_M1912	UCS	K.2.1
Wyness	Martin		DC_E0043		K.3.18
Wynn	Gareth		DC_M4557	UCS	K.2.1
Wynn	Jon		DC_M1587	UCS	K.2.1
Wynn	Tina		DC_M5206	UCS	K.2.1
Wyvekens	Nadja		DC_M6558	UCS	K.2.1
Wyzga	Gabriel		DC_M5066	UCS	K.2.1
Yakes	Steven		DC_M1850	UCS	K.2.1
Yakovakis	Andrea		DC_M3641	UCS	K.2.1
Yamada	Seiji		DC_PHO0043		K.3.5, K.3.6, K.3.11, K.3.12
Yamada	Seiji		DC_PHW0012		K.3.1, K.3.6, K.3.12, K.3.18
Yandle	Jo		DC_M6294	UCS	K.2.1
Yanez	Mario		DC_M2979	UCS	K.2.1
Yannell	Michael		DC_M5433	UCS	K.2.1
Yanoff	Steven		DC_M5047	UCS	K.2.1
Yarbrough	Jim		DC_M0038		K.2.2
Yarger	Andrea		DC_M5965	UCS	K.2.1
Yarger	James C.		DC_M2009	UCS	K.2.1
Yarrow	Arthur T		DC_M2137	UCS	K.2.1
Yasko	S.J.		DC_M5543	UCS	K.2.1
Yates	Nicholas		DC_M7122	UCS	K.2.1
Yeager	Will		DC_M5951	UCS	K.2.1
Yeargain	Greg		DC_M1334	UCS	K.2.1
Yearman	John		DC_E0273		K.3.1, K.3.10, K.3.13
Yeatman	Paula		DC_M3402	UCS	K.2.1
Yeo	Jeremy		DC_M0447		K.2.1
Yiannatji	Helen		DC_M1435	UCS	K.2.1
Yona NooN	Wendy		DC_M0712		K.2.1
York	Carole		DC_M3460	UCS	K.2.1
York	Linda		DC_M6523	UCS	K.2.1
York-Erwin	Nancy		DC_M1907	UCS	K.2.1
Young	Billie		DC_M0881	UCS	K.2.1
Young	Carl		DC_M2806	UCS	K.2.1
Young	Carl		DC_M4039	UCS	K.2.1
Young	Carroll		DC_M2199	UCS	K.2.1
Young	David		DC_M2430	UCS	K.2.1
Young	Ginger		DC_M5781	UCS	K.2.1
Young	Ginger		DC_M5782	UCS	K.2.1
Young	Graeme		DC_M7861		K.2.3
Young	Helen		DC_M0143		K.2.1
Young	J		DC_M5331	UCS	K.2.1
Young	Jane		DC_M5702	UCS	K.2.1
Young	Jock		DC_M1101	UCS	K.2.1
Young	Lois		DC_M5787	UCS	K.2.1
Young	Louise		DC_M4488	UCS	K.2.1
Young	Nancy		DC_M0528		K.2.1
Young	Shirley		DC_M3568	UCS	K.2.1
Young	Stephan		DC_PHO0003	Union of Concerned Scientists	K.3.4, K.3.5, K.3.11, K.3.12, K.3.13, K.3.15, K.4
Young	Steven		DC_O0001	Union of Concerned Scientists	K.3.9
Young	Andrew		DC_M7540	UCS	K.2.1

Last Name	First Name	Additional Commenters	Comment Document Number	Commenter Organization	Subsection Where Comment is Addressed
Younger	Lanny		DC_M4590	UCS	K.2.1
Younger	Wes		DC_M7188	UCS	K.2.1
Youngkins	George		DC_M7538	UCS	K.2.1
Youngquist	Laurie		DC_M2256	UCS	K.2.1
Youngquist	Laurie		DC_M6526	UCS	K.2.1
Young-Sklar	Rachel		DC_M5900	UCS	K.2.1
Youngson	Patricia		DC_M4617	UCS	K.2.1
Youtie	Berta		DC_M0657		K.2.1
Yudis	Jonathan		DC_M7672	UCS	K.2.1
Yudis	Jonathan		DC_M7678	UCS	K.2.1
Yuenger	Arthur		DC_M4639	UCS	K.2.1
Zabinski	James		DC_M1993	UCS	K.2.1
Zack	James		DC_M2383	UCS	K.2.1
Zahakos	James		DC_M4665	UCS	K.2.1
Zahner	Glenda		DC_M5592	UCS	K.2.1
Zai	Gabriel		DC_M2263	UCS	K.2.1
Zai	Rob		DC_M2357	UCS	K.2.1
Zaitlin	J.		DC_M3814	UCS	K.2.1
Zaleon	Janet		DC_M6043	UCS	K.2.1
Zallen	Robi	Barry Zallen	DC_M1287	UCS	K.2.1
Zamboni	Jean		DC_M7516	UCS	K.2.1
ZamEk	Jill		DC_E0172	San Luis Obispo Mothers for Peace	K.3.11
ZamEk	Jill		DC_M0227	San Luis Obispo Mothers for Peace	K.3.11
Zangrando	Frederica		DC_M7794		K.3.1, K.3.7, K.3.10
Zapalowski	Leonard		DC_M4054	UCS	K.2.1
Zappone	Mark		DC_M2682	UCS	K.2.1
Zaragosa	Alfonso		DC_M6296	UCS	K.2.1
Zarchin	Natalie		DC_M6773	UCS	K.2.1
Zarchin	Paul		DC_M4629	UCS	K.2.1
Zarember	Irving		DC_M3353	UCS	K.2.1
Zari III	Eliseo		DC_M6950	UCS	K.2.1
Zaroff	Barbara		DC_M0633		K.2.1
Zaroff	Barbara		DC_M6816	UCS	K.2.1
Zarowitz	Jay		DC_M0796	UCS	K.2.1
Zarrella	Laura		DC_M1759	UCS	K.2.1
Zarri	Jason		DC_M2759	UCS	K.2.1
Zaslavsky	Claudia		DC_M7562	UCS	K.2.1
Zaslavsky	Sam		DC_M7197	UCS	K.2.1
Zatrine	Barbara		DC_M4821	UCS	K.2.1
Zaugg	Marion		DC_M2820	UCS	K.2.1
Zavada	Rebecca		DC_M3263	UCS	K.2.1
Zavada	Rebecca		DC_M5290	UCS	K.2.1
Zebolsky	Mary Ann		DC_M6878	UCS	K.2.1
Zebolsy	Donald M		DC_M2405	UCS	K.2.1
Zebuth	Herbert		DC_M7943		K.2.1
Zechmeister	Gisela		DC_M5501	UCS	K.2.1
Zeeb-Roman	Joan		DC_M0319		K.2.1
Zeff	David		DC_M0068		K.2.1
Zeichner	Walter		DC_M2692	UCS	K.2.1
Zeidman	Jonathan		DC_M1781	UCS	K.2.1
Zeigerman	Taina		DC_M1176	UCS	K.2.1
Zeiler	Andrew		DC_M2324	UCS	K.2.1
Zeiler	Eric		DC_M0754		K.2.1
Zeinstra	Juanita		DC_M0791	UCS	K.2.1
Zelinski	Michael		DC_M1368	UCS	K.2.1
Zeller	Rudy		DC_M6648	UCS	K.2.1
Zemek	Ruth		DC_M4549	UCS	K.2.1

Last Name	First Name	Additional Commenters	Comment Document Number	Commenter Organization	Subsection Where Comment is Addressed
Zentura			DC_M3963	UCS	K.2.1
Zhuang	Lou Xiu		DC_M1249	UCS	K.2.1
Ziegler	Ralph		DC_M5959	UCS	K.2.1
Ziemer	John		DC_M7779		K.2.3
Ziff	Margery		DC_M0310		K.2.1
Zilkowski	David		DC_M7240	UCS	K.2.1
Zimmer	Audrey		DC_M1012	UCS	K.2.1
Zimmerle	Julie		DC_M7381	UCS	K.2.1
Zimmerlee	Cassie		DC_M5924	UCS	K.2.1
Zimmerman	Marc		DC_M4205	UCS	K.2.1
Zimmerman	Paulette		DC_M5043	UCS	K.2.1
Zimmerman	Rebecca		DC_M0890	UCS	K.2.1
Zimmerman	Sue		DC_M4592	UCS	K.2.1
Zimmermann	Muriel		DC_M2257	UCS	K.2.1
Zimnie	John		DC_M3660	UCS	K.2.1
Zink	Joseph		DC_M3889	UCS	K.2.1
Zinsser	John S.		DC_M0037		K.3.1, K.3.2, K.3.3, K.3.10
Zittrain	Jeff		DC_M6585	UCS	K.2.1
Zoblotsky	Linda		DC_E0109		K.3.1, K.3.3, K.3.5, K.3.12
Zochert	Kyle		DC_M4820	UCS	K.2.1
Zoellner	Jay		DC_M4304	UCS	K.2.1
Zographou	Nora		DC_M1286	UCS	K.2.1
Zolan	David		DC_M7084	UCS	K.2.1
Zoldak	Loretta		DC_M3290	UCS	K.2.1
Zondlo	Anne		DC_M2164	UCS	K.2.1
Zook	Pamela		DC_M0150		K.2.1
Zorn	Kathleen		DC_M3355	UCS	K.2.1
Zoulalian	Nancy		DC_M5008	UCS	K.2.1
Zschaler	William		DC_M7520	UCS	K.2.1
Zschaler	William		DC_M7521	UCS	K.2.1
Zukowski	Catherine		DC_M5031	UCS	K.2.1
Zur	R.		DC_M1027	UCS	K.2.1
Zusne	Megan		DC_M6880	UCS	K.2.1
Zyla	Alison		DC_M7365	UCS	K.2.1

K.2 Template Letters

The MDA identified four template letters that were received via e-mail, facsimile, or U.S. postal service. These template letters are categorized as Comment Template A, B, C, and D. There were some variations of these template letters; therefore, the following sections include randomly selected variations of these letters. Comment documents that were included as variations of each template included several comment themes. Although the specific wording varied slightly the comment themes were the same. All of the comment documents in this group included some or all of the comment themes. The following sections include examples of the template letters, identified comment themes and the MDA's responses to those themes.

K.2.1 Comment Template A

K.2.1.1 Examples of Template A

October 14, 2004

Missile Defense Agency
BMDS PEIS
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Dear Mr. Lehner,

I am writing today to support the "No Action" alternative to deploying a missile defense system. The United States should not deploy a missile defense system unless it will improve the overall ecological, political, and security environment. On all three grounds, the proposed system fails.

Deployment of the Bush administration's proposed missile defense system threatens the global environment. It will increase the likelihood of a nuclear catastrophe by impelling Russia to maintain a larger nuclear arsenal on high alert than it otherwise would, and by driving China to build and deploy a larger arsenal than it otherwise would. The impact of a nuclear war, either accidental or intentional, would dwarf any other environmental nightmare scenario one can envision.

Moreover, the system does nothing to improve our security environment. It has yet to be tested in realistic conditions and would be ineffective against a real attack.

Deployment should be halted until the Programmatic Environmental Impact Statement is finished and the system succeeds in realistic testing.

Sincerely,

Oct 13, 2004

Rick Lehner
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Dear Mr. Rick Lehner,

I am writing today to support the "No Action" alternative to deploying a missile defense system. The United States should not deploy a missile defense system unless it will improve the overall ecological, political, and security environment. On all three grounds, the proposed system fails.

Deployment of the Bush administration's proposed missile defense system threatens the global environment. It will increase the likelihood of a nuclear catastrophe by impelling Russia to maintain a larger nuclear arsenal on high alert than it otherwise would, and by driving China to build and deploy a larger arsenal than it otherwise would. The impact of a nuclear war, either accidental or intentional, would dwarf any other environmental nightmare scenario one can envision.

Moreover, the system does nothing to improve our security environment. It has yet to be tested in realistic conditions and would be ineffective against a real attack.

Deployment should be halted until the Programmatic Environmental Impact Statement is finished and the system succeeds in realistic testing.

Sincerely,

K.2.1.2 Template A Comment Themes and Responses

Comment Theme 1. The BMDS would create an arms race "…by driving China to develop and deploy a larger arsenal than it otherwise would."

Response. These types of statements are conjectural in nature and are not appropriately addressed in a NEPA environmental analysis. Therefore, comments concerning the potential effect of the BMDS on the accumulation of weapons by other nations or groups were determined to be outside the scope of the BMDS PEIS.

Comment Theme 2. "Voting" for or "supporting" the No Action Alternative presented in the BMDS PEIS or supporting consideration of a "real" No Action Alternative.

Response. The CEQ's September 2002 report titled *CEQ Task Force Review of the NEPA Process: Summary of Public Comments* stated "It is important to recognize that the consideration of public comment is not a vote-counting process in which the outcome is determined by the majority opinion. Relative depth of feeling and interest among the public can serve to provide a general context for decision-making. However, it is the appropriateness, specificity, and factual accuracy of comment content that serves to provide the basis for modifications to planning documents and decisions. Further, because respondents are self-selected, they do not constitute a random or representative public sample." The comment period for the Draft PEIS does not encompass a voting

process for the alternatives. Therefore, these comments do not require a substantive response.

As noted in CEQ's "Forty Most Asked Questions", there are two interpretations of the No Action Alternative depending on the nature of the proposal being evaluated. In situations where "no action" is illustrated in instances involving Federal decisions on proposals for a project, "no action" would mean the proposed activity would not take place. In situations that involve an action such as updating a land management plan where ongoing programs initiated under existing legislation and regulations will continue, even as new plans are developed, "no action" may be thought of in terms of continuing with the present course of action until that action is changed. It is further noted that to construct an alternative based on no land management at all would be a useless academic exercise. For this PEIS, because the proposed action involves the integration of existing discrete missile defense systems, the no action alternative would be to continue with existing stand-alone systems; not to scrap all existing systems like the PATRIOT missile already in use in theater defense by U.S. forces.

Comment Theme 3. The BMDS has not been tested and would be ineffective in a real attack.

Response. This PEIS does not address issues related to DoD threat assessment policy or the technological feasibility of missile defense design. These comments regarding the effectiveness or ineffectiveness of the proposed system in defeating threat missiles were determined to be outside the scope of the BMDS PEIS and therefore do not require a substantive response. MDA has considered the environmental impacts of system integration flight testing in this PEIS. This testing would help MDA fine tune the various systems components of the BMDS and continue to identify additional functional capabilities needed to assure the security and efficacy of the system. However, the President made the decision to deploy a limited defensive capability to ensure the safety and security of the U.S. homeland while the system was being further developed and tested. Also, because the BMDS is a spirally developed defensive system, there may never be the ultimate deployment of a single architecture or even of a set of system architectures. Continuous improvement, technology development, and testing are critical to MDA's development of the BMDS.

Comment Theme 4. The BMDS would not improve the political environment.

Response. These types of statements are the opinion of the commenter and thus are not appropriately addressed in an environmental analysis. Therefore, comments concerning the potential effect of the BMDS on terrorism or global stability were determined to be outside the scope of the BMDS PEIS and do not require a substantive reply.

Comment Theme 5. The BMDS would not improve the security environment.

Response. These types of statements are the opinion of the commenter and thus are not appropriately addressed in an environmental analysis. Therefore, comments concerning the ability of the BMDS to defend against a realistic threat or provide safety for the U.S. were determined to be outside the scope of the BMDS PEIS and do not require a substantive reply.

Comment Theme 6. Deployment of the BMDS should be halted until the PEIS is finished and the system succeeds in realistic testing.

Response. This PEIS considers the environmental impacts from possible realistic testing scenarios that could be used to test the BMDS. However, this environmental analysis is not the appropriate venue to determine the outcome of testing or to determine when or how to deploy an integrated BMDS. Therefore, comments concerning deployment of the BMDS only after the success of realistic testing were determined to be outside of the scope of the BMDS PEIS and do not require a substantive reply.

Comment Theme 7. The BMDS would not improve the ecological environment.

Response. This comment reflects the opinion of the commenter. The PEIS analyzes the environmental impacts of the implementation of an integrated BMDS as discussed under Alternative 1 in Section 4.1.1; this includes the use of weapons, sensors, Command and Control, Battle Management, and Communications (C2BMC), and support assets for all of the resource areas described in Section 3. The environmental impacts of Test Integration under Alternative 1 are analyzed in Section 4.1.2. The impacts of activities at Locations Outside the Continental U.S. are discussed in Section 4.1.3. The cumulative impacts associated with Alternative 1 are considered in Section 4.1.4. The environmental impacts associated with Alternative 2 are addressed in Sections 4.2.1 Impacts Analysis, 4.2.2 Test Integration, and 4.2.3 Cumulative Impacts. The impacts of the No Action Alternative are addressed in Section 4.3. Thus the BMDS PEIS provides decision makers with information regarding potential environmental impacts of the proposed implementation alternatives so that effective decisions can be made about system implementation in the context of impacts to the environment.

K.2.2 Comment Template B

K.2.2.1 Examples of Template B

Sent: Monday, September 20, 2004 1:58 PM
To: mda.bmds.peis
Subject: Public Comment Re: Star Wars

To whom it May Concern:

I am writing to support the "No Action" alternative for the following reasons:

1) This new Star Wars program as outlined in the PEIS will be ***destabilizing*** thus creating new momentum to move the deadly and dangerous arms race into the heavens. This will create more global instability.

2) Testing and deployment of weapons in space will create massive amounts of new ***space debris*** making the environment of space even more contaminated and thus unavailable for future space flight.

2) This new Star Wars plan will be ***extraordinarily expensive*** requiring massive cuts in health care, education, public services, and environmental clean-up.

3) The likely use of ***nuclear power*** for eventual space-based weapons would be an environmental disaster.

4) Space-based weapons, described in the PEIS as being "defensive", could easily serve an ***offensive purpose*** as outlined in the Space Command's *Vision for 2020* that says the U.S. will "deny" other nations the use of space.

5) Toxic ***rocket exhaust pollution*** is now contaminating the Earth and punching a hole in the ozone layer. This plan would dramatically expand these polluting launches.

In light of the above and the huge cost of this plan at a time when people in our country and around the globe are suffering so greatly due to lack of basic human needs, I feel it is morally imperative to turn away from this project and work for the good of humanity on this earth.

Sincerely,

Sent: Wednesday, November 10, 2004 9:15 AM
To: mda.bmds.peis
Subject: Ballistic Missile Defense System

I understand the public is invited to comment on PEIS before Nov 17th. So here I am.
I was a high school science teacher for 24 years. So I have studied and learned about the dangers and effects of radiation.
I believe the current "no action alternative" is insuffiicient and should be rewritten for the following reasons:
1) Nuclear reactors and systems should be kept out of space because that move will only increase the arms race.
2) Even though the purpose of space-based weapons would be "defensive", they could be used for "offensive" purposes. (we don't want to start any nuclear wars. I have had a first-hand view of Hiroshima in 1945 since I was overseas with the USO entertainung the troops.)
3) We don't want to increase polluting rocket launches. (The ozone layer is already being damaged thus creating climate change.)
The money could be put to much better use for health care, education, public services, etc.

Sent: Friday, November 12, 2004 8:56 AM
To: mda.bmds.peis
Subject: pentagon star wars plan

I support the "No Action Alternative" in relation to the pentagon star wars plan because of the following reasons: (1) rocket exhuast and space debris from testing in space could pollute outer space and increase the ozone depletion already exixsting and (2) the fabulous ly expensive cost of this program. The Bush Administration has already created record debts and I don't see any hope for this problem being solved anytime soon. There are enough problems on earth without making more in space. I am not naive and realize that the Bush Administration loves giving money to the military industrial corporate complex, but aren't they already profiting enough on violence and death with Bush's invasion of Iraq? Money in defense of this country could be better spent on health care and social initiatives than on ridiculous space projects.

I firmly support the "No Action Initiative."

K.2.2.2 Template B Comment Themes and Responses

Comment Theme 1. The BMDS would be extraordinarily expensive.

Response. Budgetary policy issues including the cost of the proposed BMDS and other DoD related acquisition programs are not part of the decision to be made in this environmental analysis. Therefore, these types of issues were determined to be outside the scope of this PEIS. This PEIS considers the environmental impacts of various alternatives to develop, test, deploy, and plan for the decommissioning of an integrated BMDS.

Comment Theme 2. The cost of the BMDS will require spending cuts in other areas.

Response. Such comments on budgetary policy issues including how Federal funds should be spent provide an expression of personal or political philosophy or opinion. These types of comments do not address the environmental issues addressed in this PEIS and are outside the scope of the analysis.

Comment Theme 3. The BMDS would create an arms race.

Response. These types of statements are the opinion of the commenter and are thus not appropriately addressed in a NEPA environmental analysis. Therefore, comments concerning the potential effect of the BMDS on the accumulation of weapons by other nations or groups were determined to be outside the scope of the BMDS PEIS.

Comment Theme 4. The BMDS could be used as an offensive weapon.

Response. BMDS weapons are described as defensive system components that could be used to destroy threat missiles. Statements including those suggesting the use of these weapons for other purposes are the opinion of the commenter and are thus considered outside of the scope of the BMDS PEIS.

Comment Theme 5. "Voting" for or "supporting" the No Action Alternative presented in the BMDS PEIS or supporting consideration of a "real" No Action Alternative.

Response. The CEQ's September 2002 report titled *CEQ Task Force Review of the NEPA Process: Summary of Public Comments* stated "It is important to recognize that the consideration of public comment is not a vote-counting process in which the outcome is determined by the majority opinion. Relative depth of feeling and interest among he public can serve to provide a general context for decision-making. However, it is the appropriateness, specificity, and factual accuracy of comment content that serves to provide the basis for modifications to planning documents and decisions. Further, because respondents are self-selected, they do not constitute a random or representative public sample." The comment period for the Draft PEIS does not encompass a voting process for the alternatives. Therefore, these comments do not require a substantive response.

As noted in CEQ's "Forty Most Asked Questions," there are two interpretations of the No Action Alternative depending on the nature of the proposal being evaluated. In situations where "no action" is illustrated in instances involving federal decisions on proposals for project "no action" would mean the proposed activity would not take place. In situations that involve an action such as updating a land management plan where ongoing programs initiated under existing legislation and regulations will continue, even as new plans are developed, "no action" may be thought of in terms of continuing with the present course of action until that action is changed. It is further noted that to construct an alternative based on no management at all would be a useless academic exercise. For this PEIS, because the proposed action involves the integration of existing discrete missile defense systems, the no action alternative would be to continue with existing stand-alone systems; not to scrap all existing systems like the PATRIOT missile already in use in theater defense by U.S. forces.

Comment Theme 6. The BMDS will be politically destabilizing.

Response. These types of statements are the opinion of the commenter and are thus not appropriately addressed in an environmental analysis. Therefore, comments concerning the potential effect of the BMDS on terrorism or global stability were determined to be outside the scope of the BMDS PEIS and do not require a substantive reply.

Comment Theme 7. The BMDS would increase environmental damage including damage to the ozone layer from rocket launch emissions.

Response. Many generic environmental issues are considered in the PEIS. However, impacts to some resource areas including Cultural Resources, Environmental Justice, Land Use, Socioeconomics, Utilities, and Visual Resources are more appropriately considered in site-specific environmental documentation. Each of these was discussed

regarding methodology and thresholds for significance to provide a “roadmap” for performing future site-specific analyses tiering from the PEIS. The following resource areas were considered in the PEIS: Air Quality, Airspace, Biological Resources, Geology and Soils, Hazardous Materials and Hazardous Waste, Health and Safety, Noise, Transportation, Water Resources, and Orbital Debris.

The PEIS analyzes the environmental impacts of the use of BMDS Components under Alternative 1 in Section 4.1.1; this includes the use of weapons, sensors, C2BMC, and support assets for all of the resource areas described above. The environmental impacts of Test Integration under Alternative 1 are analyzed in Section 4.1.2. The impacts of activities at Locations Outside the Continental U.S. are discussed in Section 4.1.3. The cumulative impacts associated with Alternative 1 are considered in Section 4.1.4. The environmental impacts associated with Alternative 2 are addressed in Sections 4.2.1 Impacts Analysis, 4.2.2 Test Integration, and 4.2.3 Cumulative Impacts. The impacts of the No Action Alternative are addressed in Section 4.3.

Specifically, damage to the ozone layer from rocket launch emissions was considered in Section 4.1.1.2 for launches of interceptors and impacts on air quality including ozone depletion in the stratosphere.

K.2.3 Comment Template C

K.2.3.1 Examples of Template C

October 20, 2004

Missile Defense Agency

MDA BMDS PEIS, c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Missile Defense Agency:

I am writing to support a real "No Action" alternative to the deployment of a missile defense system. This means no further testing, development, or deployment. Deployment of such a system threatens a new nuclear arms race, puts the global environment at risk, and does not improve the security of the United States.

Deployment of a missile defense system will increase the likelihood of a nuclear catastrophe. It impels Russia to maintain a larger nuclear arsenal on high alert than it otherwise would. Deployment also drives China to deploy a larger arsenal. The impact of a nuclear war, whether accidental or intentional, would dwarf any other environmental nightmare one can envision.

Moreover, the system does not improve our security. So far, it has yet to be tested in realistic conditions and would be ineffective against an attack. While in the future the capabilities of the system can be expanded at great expense, these developments are likely to be made useless by the newly improved weapons and countermeasures of potential adversaries.

Finally, the $10 billion a year being spent on missile defense should be spent on measures that are more effective and environmentally sound. One example is the program to secure stockpiles of nuclear weapons material in the former Soviet Union and other countries.

The testing, development, and deployment of the missile defense system should be halted, given that the system leads to environmental harm and potentially to environmental devastation and does so without improving the security of the United States.

Sincerely,

October 24, 2004

Missile Defense Agency

MDA BMDS PEIS, c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Missile Defense Agency:

I am writing to support a real "No Action" alternative to the deployment of a missile defense system. This means no further testing, development, or deployment. Deployment of such a system threatens a new nuclear arms race, puts the global environment at risk, and does not improve the security of the United States. Deployment of a missile defense system will increase the likelihood of a nuclear catastrophe. It impels Russia to maintain a larger nuclear arsenal on high alert than it otherwise would.
Deployment also drives China to deploy a larger arsenal. The impact of a nuclear war, whether accidental or intentional, would dwarf any other environmental nightmare one can envision. Moreover, the system does not improve our security. So far, it has yet to be tested in realistic conditions and would be ineffective against an attack. While in the future the capabilities of the system can be expanded at great expense, these developments are likely to be made useless by the newly improved weapons and countermeasures of potential adversaries. Finally, the $10 billion a year being spent on missile defense should be spent on measures that are more effective and environmentally sound. One example is the program to secure stockpiles of nuclear weapons material in the former Soviet Union and other countries.

The testing, development, and deployment of the missile defense system should be halted, given that the system leads to environmental harm and potentially to environmental devastation and does so without improving the security of the United States.

Sincerely,

November 16, 2004

Missile Defense Agency
MDA BMDS PEIS, c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Missile Defense Agency:

I am writing to support a real "No Action" alternative to the deployment of a missile defense system. This means no further testing, development, or deployment. Deployment of such a system threatens a new nuclear arms race, puts the global environment at risk, and does not improve the security of the United States.

Moreover, the system does not improve our security. So far, it has yet to be tested in realistic conditions and would be ineffective against an attack. While in the future the capabilities of the system can be expanded at great expense, these developments are likely to be made useless by the newly improved weapons and countermeasures of potential adversaries.

This is a waste of my hard-earned tax money. I do not feel more secure with such a system. I instead feel very insecure. Nuclear weapons are not the way to make me feel secure or defended. I think it would be better to use the monies on systems that are environmentally sound and are not potentially hazardous to me and others who are being defended.

The testing, development, and deployment of the missile defense system should be halted, given that the system leads to environmental harm and potentially to environmental devastation and does so without improving the security of the United States.

Sincerely,

K.2.3.2 Template C Comment Themes and Responses

Comment Theme 1. Monies slated for the BMDS should be spent on other programs or services.

Response. Comments on budgetary policy issues including how Federal funds should be spent provide an expression of personal or political philosophy or opinion. These types of comments do not address the environmental issues addressed in this PEIS and are outside the scope of the analysis.

Comment Theme 2. Deployment of the BMDS would create an arms race.

Response. These types of statements are the opinion of the commenter and thus are not appropriately addressed in a NEPA environmental analysis. Therefore, comments concerning the potential effect of the BMDS on the accumulation of weapons by other nations or groups were determined to be outside the scope of the BMDS PEIS.

Comment Theme 3. Supporting a "real" No Action Alternative.

Response. As noted in CEQ's "Forty Most Asked Questions," there are two interpretations of the No Action Alternative depending on the nature of the proposal being evaluated. In situations where "no action" is illustrated in instances involving Federal decisions on proposals for project, "no action" would mean the proposed activity would not take place. In situations that involve an action such as updating a land management plan where ongoing programs initiated under existing legislation and regulations will continue, even as new plans are developed, "no action" may be thought of in terms of continuing with the present course of action until that action is changed. It is further noted that to construct an alternative based on no management at all would be a useless academic exercise. For this PEIS, because the proposed action involves the integration of existing discrete missile defense systems, the no action alternative would be to continue with existing stand-alone systems; not to scrap all existing systems like the PATRIOT missile already in use in theater defense by U.S. forces.

Comment Theme 4. The BMDS has not been tested and would be ineffective in a real attack.

Response. This PEIS does not address issues related to DoD threat assessment policy or the technological feasibility of missile defense design. These comments regarding the technological feasibility of defeating threat missiles are the opinion of the commenter and were determined to be outside the scope of the BMDS PEIS and therefore do not require a substantive response. MDA has considered the environmental impacts of system integration flight testing in this PEIS. This testing would help MDA fine tune the various

systems components of the BMDS and continue to identify additional functional capabilities needed to assure the security and efficacy of the system. However, the President made the decision to deploy a limited defensive capability to ensure the safety and security of the U.S. homeland while the system was being further developed and tested. Also, because the BMDS is a spirally developed defensive system there may never be the ultimate deployment of a single architecture or even of a set of system architectures. Continuous improvement, technology development, and testing are critical to MDA's development of the BMDS.

Comment Theme 5. Potential adversaries will develop new weapons and countermeasures to render the BMDS ineffective.

Response. These types of statements are the opinion of the commenter and are thus not appropriately addressed in an environmental analysis. Therefore, comments concerning the potential effect of the BMDS on terrorism or global stability were determined to be outside the scope of the BMDS PEIS and do not require a substantive reply.

Comment Theme 6. The BMDS will not improve the security of the U.S.

Response. These types of statements are the opinion of the commenter and are thus not appropriately addressed in an environmental analysis. Therefore, comments concerning the ability of the BMDS to defend against a realistic threat or provide safety for the U.S. were determined to be outside the scope of the BMDS PEIS and do not require a substantive reply.

Comment Theme 7. The testing, development, and deployment of the BMDS damages the environment.

Response. The PEIS analyzes the environmental impacts of the implementation of the BMDS under Alternative 1 in Section 4.1.1, this includes the use of weapons, sensors, C2BMC, and support assets for all of the resource areas described in Section 3. The environmental impacts of Test Integration under Alternative 1 are analyzed in Section 4.1.2. The impacts of activities at Locations Outside the Continental U.S. are discussed in Section 4.1.3. The cumulative impacts associated with Alternative 1 are considered in Section 4.1.4. The environmental impacts associated with Alternative 2 are addressed in Sections 4.2.1 Impacts Analysis, 4.2.2 Test Integration, and 4.2.3 Cumulative Impacts. The impacts of the No Action Alternative are addressed in Section 4.3.

K.2.4 Comment Template D

K.2.4.1 Examples of Template D

Sent: Monday, November 08, 2004 6:52 PM
To: mda.bmds.peis
Subject: Comments on New Star Wars Program

To whom it may concern re: The new Star Wars program.

I strongly oppose any and all new Star Wars programs. The current "no action alternative" is insufficient, and the PEIS must be re-written for the following reasons:

- **Spending**. Time has proven that these types of programs take on a life of their own. Much of that life is an economic existence based on technological failures; a deadline missed, an unanticipated expense - and then evolves a process fueled by a new economic dependence on the American government tax dollars to succeed. We are not able to continue to fund such programs, which by their very nature create new dependencies on an already fragile economy.
- **Ecological Factors**. As an American living and traveling abroad, I live daily with the pollution created by economies driven by borrowed and irresponsible 'second-hand ' American technology gone amuck. Over time another new American technology will, in all probability, create envy and be used in yet another irresponsible way. The present American fear of escalating international nuclear proliferation is a case in point.
- **Moral Perspectives**. Much of the just completed American Presidential election was based on a development of ideas surrounding an American moral response based on fear of aggression and terrorism. Extending that argument to the whole world, what is the meaning of a common and global morality regarding this issue? My conclusion is that this proposal ignores the voices of much of the world.
- **Initiatives Based On Fear**. Feeding the fears of people may make this initiative popular with some, but it is the fear that must be addressed and not another military "objective" based on tactics that the Big Bad Wolf may get you, so prepare a house that is unassailable. Another model is needed.
- **Who Suffers?** To name but a few, there are the poor who continue to suffer from monies directed elsewhere, those countries that do not have a voice because they sit at an uneven economic table and an uneven power table with the rest of the world.
- **Tracking the Issue.** In a world that already has a short attention span for important issues and is daily saturated in such a way that we do not track these issues, it is critical that we not give people yet another initiative that will be quickly forgotten and, therefore, we will not pay attention to over time. This issue has huge and lasting global consequences.
- **Power**. Our global situation is already precarious and filled with many questions over which United States has exerted its power. Presently, this power is often perceived of as unjust. To add yet another initiative that will add to this feeling is not a model for a just society.

For the above and many other reasons, **I believe that the current "no action alternative" is insufficient, and the PEIS must be re-written**.

To whom it may concern re: The new Star Wars program.

I strongly oppose any and all new Star Wars programs. The current "no action alternative" is insufficient, and the PEIS must be re-written for the following reasons:

Spending. Time has proven that these types of programs take on a life of their own. Much of that life is an economic existence based on technological failures; a deadline missed, an unanticipated expense - and then evolves a process fueled by a new economic dependence on the American government tax dollars to succeed. We are not able to continue to fund such programs, which by their very nature create new dependencies on an already fragile economy.
Ecological Factors. As an American living and traveling abroad, I live daily with the pollution created by economies driven by borrowed and irresponsible 'second-hand ' American technology gone amuck. Over time another new American technology will, in all probability, create envy and be used in yet another irresponsible way. The present American fear of escalating international nuclear proliferation is a case in point.
Moral Perspectives. Much of the just completed American Presidential election was based on a development of ideas surrounding an American moral response based on fear of aggression and terrorism. Extending that argument to the whole world, what is the meaning of a common and global morality regarding this issue? My conclusion is that this proposal ignores the voices of much of the world.
Initiatives Based On Fear. Feeding the fears of people may make this initiative popular with some, but it is the fear that must be addressed and not another military "objective" based on tactics that the Big
Bad Wolf may get you, so prepare a house that is unassailable. Another
model is needed.
Who Suffers? To name but a few, there are the poor who continue to suffer from monies directed elsewhere, those countries that do not have a voice because they sit at an uneven economic table and an uneven power
table with the rest of the world.
Tracking the Issue. In a world that already has a short attention span for important issues and is daily saturated in such a way that we do not track these issues, it is critical that we not give people yet another initiative that will be quickly forgotten and, therefore, we will not pay attention to over time. This issue has huge and lasting global consequences.
Power. Our global situation is already precarious and filled with many questions over which United States has exerted its power. Presently, this power is often perceived of as unjust. To add yet another initiative that will add to this feeling is not a model for a just society.

For the above and many other reasons, I believe that the current "no action alternative" is insufficient, and the PEIS must be re-written.

K.2.4.2 Template D Comment Themes and Responses

Comment Theme 1. The BMDS would depend on American government tax dollars and would stress the economy.

Response. Budgetary policy issues including the cost of the proposed BMDS and other DoD related programs are not part of the decision to be made in this environmental analysis. Therefore, these types of issues were determined to be outside the scope of this PEIS. This PEIS considers the environmental impacts of various alternatives to develop, test, deploy, and plan for the decommissioning of an integrated BMDS.

Comment Theme 2. The BMDS would cause monies to be diverted away from other services and programs.

Response. Comments on budgetary policy issues including how Federal funds should be spent provide an expression of personal or political philosophy or opinion. These types of comments do not address the environmental issues addressed in this PEIS and are considered outside the scope of the analysis.

Comment Theme 3. Supporting a "real" No Action Alternative.

Response. As noted in CEQ's "Forty Most Asked Questions," there are two interpretations of the No Action Alternative depending on the nature of the proposal being evaluated. In situations where "no action" is illustrated in instances involving Federal decisions on proposals for project, "no action" would mean the proposed activity would not take place. In situations that involve an action such as updating a land management plan where ongoing programs initiated under existing legislation and regulations will continue, even as new plans are developed, "no action" may be thought of in terms of continuing with the present course of action until that action is changed. It is further noted that to construct an alternative based on no management at all would be a useless academic exercise. For this PEIS, because the proposed action involves the integration of existing discrete missile defense systems, the no action alternative would be to continue with existing stand-alone systems; not to scrap all existing systems like the PATRIOT missile already in use in theater defense by U.S. forces.

Comment Theme 4. The BMDS would add to an already precarious global situation.

Response. These types of statements are the opinion of the commenter and thus are not appropriately addressed in an environmental analysis. Therefore, comments concerning the potential effect of the BMDS on terrorism or global stability were determined to be outside the scope of the BMDS PEIS and do not require a substantive reply.

Comment Theme 5. Opposition to the "Star Wars" program.

Response. Alternative 1 would not include the use of space-based weapons while Alternative 2 would include the use of weapons from space-based platforms. While this PEIS considered two implementing alternatives for the BMDS, this PEIS performed an environmental analysis, not a policy analysis of the alternatives. The comments that were collectively summarized and grouped as *"Opposed to Weapons in Space"* were comments that expressed a philosophy, value, or opposition to an action. These comments were not substantive comments on the scope of the *environmental analysis* in this PEIS regarding the use of space-based weapons but rather statements against the *policy* of using space-based weapons. These comments appear to fit within the definition provided for non-substantive comments, i.e., comments that express a philosophy, value, or support or opposition for an action; therefore, it would appear to be appropriate to include them in this grouping. These types of issues are not part of the decision to be

made in this environmental analysis. Therefore, these comments were determined not to require a substantive reply.

Comment Theme 6. The BMDS technology will eventually be used in an irresponsible way leading to ecological risk.

Response. Many generic or non-specific environmental issues are considered in the PEIS. Some resource areas including Cultural Resources, Environmental Justice, Land Use, Socioeconomics, Utilities, and Visual Resources are more appropriately considered in site-specific environmental documentation. Each of these was discussed regarding methodology and thresholds for significance to provide a "roadmap" for performing future site-specific analyses tiering from the PEIS. The following resource areas were considered in the PEIS: Air Quality, Airspace, Biological Resources, Geology and Soils, Hazardous Materials and Hazardous Waste, Health and Safety, Noise, Transportation, Water Resources, and Orbital Debris.

The PEIS analyzes the environmental impacts of the use of BMDS Components under Alternative 1 in Section 4.1.1, this includes the use of weapons, sensors, C2BMC, and support assets for all of the resource areas described above. The environmental impacts of Test Integration under Alternative 1 are analyzed in Section 4.1.2. The impacts of activities at Locations Outside the Continental U.S. are discussed in Section 4.1.3. The cumulative impacts associated with Alternative 1 are considered in Section 4.1.4. The environmental impacts associated with Alternative 2 are addressed in Sections 4.2.1 Impacts Analysis, 4.2.2 Test Integration, and 4.2.3 Cumulative Impacts. The impacts of the No Action Alternative are addressed in Section 4.3.

K.3 Out of Scope Comments

After determining which comment documents had text that was the same as or similar to that provided in one of the four types of template letters, all comments were reviewed to determine if they addressed substantive or out of scope comments. Out of scope comments were grouped according to their subject matter and in accordance with 40 Code of Federal Regulations (CFR) § 1503.4 and "Forty Most-Asked Questions Concerning CEQ's National Environmental Policy Act Regulations" these comments were briefly summarized and the reasons why these comments were considered out of scope were documented.[2] Each subject matter topic and a summary of the comments received are presented in Sections K.3.1 through K.3.18. Examples of specific comments related to each topic are also provided. Following the summary and examples is an explanation of why these comments were determined to be out of scope. All comments received have been noted and will be included in the administrative record for this PEIS.

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[2] The Council on Environmental Quality has determined that when a large volume of comments are received it is appropriate to summarize the comments rather than reproduce the comments in the NEPA document.

K.3.1 Opposed to the BMDS

Summary. Many commenters stated that they were opposed to the testing and/or development of missile defense technologies including those proposed for the BMDS.

Examples. "I say NO STAR WARS" (DC_E0017), "This Ballistic Missile Defense system has to be one of the most stupid plans ever invented to waste the resources of the people of the USA and create a new arms race based in space." (DC_E0021), "I strongly oppose any form of missle [sic.] defense system plan for space.NO! NO! NO!" (DC_E0062), "Pie in sky while overlooking bombs in our backyard - is NOT Smart and definitely dangerous. Shelve it!" (DC_E0089)

Response. As stated in Section 1.2 of the Draft BMDS PEIS, on January 2, 2002, Secretary of Defense Rumsfeld issued a directive to the DoD to establish a single development program for all the work needed to design, develop, and test elements of an integrated BMDS that would operate under a newly titled MDA. Therefore, it has been determined that a BMDS should be developed. This PEIS considers the environmental impacts of various implementing alternatives for such a system. Therefore, comments regarding opposition to the BMDS *per se* and other related policy issues were determined to be outside the scope of this environmental analysis.

K.3.2 Missile Defense Program is too Expensive, Opposed to Funding the BMDS

Summary. Many commenters expressed a belief that that missile defense development and testing is too expensive.
Examples. "I find the other two options a waste of money and a morally empty endeavor." (DC_E0029), "The precision in timing and location needed in order to intercept a missile makes this an unrealistic program, especially considering the outrageous costs of it." (DC_E0050), "Going forward with the planned BMDS appears both scientifically irrational, highly costly, and dangerous to our national security." (DC_E0074)

Response. Comments on budgetary policy issues including the cost of the proposed BMDS and other DoD related programs are not part of the decision to be made in this environmental analysis. Therefore, these types of issues were determined to be outside the scope of this PEIS. This PEIS considers the environmental impacts of various alternatives to develop, test, deploy, and plan for the decommissioning of an integrated BMDS.

K.3.3 Federal Funds should be used to Address Domestic or International Problems

Summary. Several commenters suggested that monies allocated to missile defense could be better spent to address other social domestic or international problems. Other commenters suggested that these funds should be spent decreasing the stockpile of

weapons in other countries rather than developing and testing a U.S. missile defense capability.

Examples. “The perception of a nation willing to forgo the funds desperately needed for education, for health and for the development of labor intensive industries that provide jobs, is the perception of a nation locked in the illusive pursuit of security, even at the risk of inducing weapons competition that will ultimately reduce security.” (DC_E0015), “Wouldn't the money be better spent on helping those countries where poverty is at levels which make people angry and may therefore lead to violence?” (DC_E0032), “Why would we incur the wrath of the rest of the world, commit to huge costs that undermine spending on the people's needs, endanger the planet's viability by further decimating its environmental balance and endanger the lives of billions?” (DC_E0055)

Response. Comments on budgetary policy issues including how Federal funds should be spent provide an expression of personal or political philosophy or opinion. These types of comments do not address the environmental issues addressed in this PEIS and are considered outside the scope of the analysis.

K.3.4 BMDS Would Create an Arms Race

Summary. Some commenters expressed concern that the development of a missile defense system by the U.S. would be viewed as a threat by other countries that would cause them to develop weapons systems to defeat the BMDS.

Examples. “First, they will multiply offensive missiles, ratcheting up the catastrophically expensive arms race.” (DC_E0007), “Its deployment unquestionably will accelerate the arms race into space - those who disagree with that likely assumption are very weak in their denial.” (DC_E0019), “This just continues the arms race.” (DC_E0058)

Response. These types of statements are the opinion of the commenter and are thus not appropriately addressed in a NEPA environmental analysis. Therefore, comments concerning the potential effect of the BMDS on the accumulation of weapons by other nations or groups were determined to be outside the scope of the BMDS PEIS.

K.3.5 Opposed to Nuclear Weapons

Summary. A few commenters stated that they were opposed to the use of nuclear weapons as part of a missile defense system. Commenters also expressed concern that another country could use a nuclear weapon to defeat the BMDS.

Examples. “Any kind of using of Nuclear weapons in this Beautiful must be abondoned [sic.] and use such things in the proper use for providing electricity.” (DC_E0010), “The planet, the human race, all of life on this unique place called Earth cannot survive one

country's global dominance from space or the use of nuclear weapons from anywhere." (DC_E0055), "We do not need any nuclear missile system." (DC_E0061)

Response. The MDA has no plans to include nuclear material as part of the BMDS; therefore the PEIS does not consider the use of nuclear material or weapons as part of the BMDS. This PEIS does not address issues related to DoD threat assessment policy or the technological feasibility of missile defense design. Therefore comments regarding opposition to use of nuclear weapons or the technological feasibility of defeating a threat nuclear warhead were determined to be outside the scope of the environmental analysis in the PEIS.

K.3.6 BMDS could be used as an Offensive Weapons System

Summary. Several commenters expressed concern that the BMDS would not be used as a defensive system but would be used as an offensive system. These commenters expressed beliefs both that the BMDS would become a first strike system and also that other countries would see the BMDS as an offensive system and a threat to their own security.

Examples. "To be truthful about the program, it is essentially an OFFENSIVE system, in every sense of the word." (DC_E0016), "Other nations are aware that the conversion of these weapons from reactive to proactive is a simple one." (DC_E0054)

Response. BMDS weapons are described as defensive system components that could be used to destroy threat missiles. Statements including those suggesting the use of BMDS weapons components for other purposes are the opinion of the commenter and thus are considered outside of the scope of the BMDS PEIS.

K.3.7 "Voting" for No Action Alternative

Summary. Many commenters stated that they were in favor of or supported the No Action Alternative identified in the Draft BMDS PEIS.

Examples. "WE FAVOR THE 'NO ACTION' ALTERNATIVE!!!!!!" (DC_E0006), "I support the "**No Action**" option--the 3rd of 3 possible options." (DC_E0033), "It is in the opinion of many with which I've conferred to submit a No Action Alternative." (DC_E0093)

Response. The CEQ's September 2002 report on Comment Received on the NEPA Task Force stated "It is important to recognize that the consideration of public comment is not a vote-counting process in which the outcome is determined by the majority opinion. Relative depth of feeling and interest among he public can serve to provide a general context for decision-making. However, it is the appropriateness, specificity, and factual accuracy of comment content that serves to provide the basis for modifications to

planning documents and decisions. Further, because respondents are self-selected, they do not constitute a random or representative public sample." The comment period for the Draft PEIS does not encompass a voting process for the alternatives. Therefore, these comments do not require a substantive response.

K.3.8 "Voting" for Alternative 1

Summary. Commenter stated that they were in favor of developing the BMDS as described under Alternative 1.

Example. "please take plan 1 astrhe best fopr a stable defence system" [sic.] (DC_E0065)

Response. Please see response to K.3.7.

K.3.9 Administrative

Summary. Several commenters submitted inquiries via e-mail or phone for administrative requests. Some of these commenters requested hard copies of the Draft BMDS PEIS. Other commenters requested additional information about the location of public hearings or whether the comment period had been extended.

Examples. "Please send me a copy by air mail if you have not already done so." (DC_E0001), "I would like to have a hard copy of the 'Ballistic Missile Defense System Draft Programmatic Environmental Impact Statement' (1 September 2004) sent to me as soon as possible- by the fastest shipping method." (DC_E0002), "I would definitely be interested in going to the hearing." (DC_E0028)

Response. Requests for alternate means of reviewing the Draft BMDS PEIS were accommodated. Responses were provided to individuals requesting additional information about the location of public hearings and the scheduled closure of the public comment period. While these comments were noted for the administrative record they do not require a substantive reply in this PEIS.

K.3.10 BMDS as a Technology Will Not Work

Summary. Several commenters expressed their belief that the technologies used as part of the BMDS would not be effective against threat missiles. Some of these commenters stated that additional realistic testing should be conducted prior to making a decision to deploy the BMDS.

Examples. "With its questionable record so far in testing, MDA, which MUST work nearly perfectly all the time to not only be effective, but safe, should not go forward." (DC_E0019), "I have read about the total unfeasibility of this program. The precision in

timing and location needed in order to intercept a missile makes this an unrealistic program, especially considering the outrageous costs of it." (DC_E0050), "There will be a "phase lag" between the time the modified software can be developed and the time it can be installed and tested; the requirement for the continual upgrading of software alone makes it unlikely that the system can be considered operational any time soon." (DC_E0076), ""A defense that does not work against a threat that does not exist"" (DC_E0077)

Response. This PEIS does not address issues related to DoD threat assessment policy or the technological feasibility of missile defense design. These comments regarding the technological feasibility of defeating threat missiles are the opinion of the commenter, were determined to be outside the scope of the BMDS PEIS and therefore do not require a substantive response. MDA has considered the environmental impacts of system integration flight testing in this PEIS. This testing would help MDA fine tune the various systems components of the BMDS and continue to identify additional functional capabilities needed to assure the security and efficacy of the system. However, the President made the decision to deploy a limited defensive capability to ensure the safety and security of the U.S. homeland while the system was being further developed and tested. Also, because the BMDS is a spirally developed defensive system there may never be the ultimate deployment of a single architecture or even of a set of system architectures. Continuous improvement, technology development, and testing are critical to MDA's development of the BMDS.

K.3.11 BMDS Encourages Terrorism, Threatens Global Stability, and Perceived as Threat by Other Nations

Summary. Several commenters expressed that the development of a BMDS would encourage those who wish the U.S. harm to resort to terrorist activities in lieu of using missiles. Some concerns were raised that the BMDS does not address the current threat against the U.S. In addition, some commenters expressed that the BMDS would lead to global instability.

Examples. "If it works, or is suspected by potential antagonists to possibly work, their response will be twofold. First, they will multiply offensive missiles, ratcheting up the catastrophically expensive arms race. Second and more importantly, they will divert their energies to produce sub-radar cruise missiles and, worse, divert their energies to smuggle WMD across our borders, weapons with no return addresses and zero warning time." (DC_E0007), "Star Wars will breed hostility to those nations implementing it and to those who "host" the stations needed for the program to run (e.g. Fylingdales in Yorkshire, UK) - this is not welcome when we want to encourage peace, not war" (DC_E0017), "It is an insane response to security concerns and will make things more unstable." (DC_E0055)

Response. These types of statements the opinion of the commenter and thus are not appropriately addressed in an environmental analysis. Therefore, comments concerning the potential effect of the BMDS on terrorism or global stability were determined to be outside the scope of the BMDS PEIS and do not require a substantive reply.

K.3.12 Opposed to Weapons in Space or "Star Wars"

Summary. Several commenters expressed that they were opposed to deploying weapons in space. Some commenters encouraged space to be used only for peaceful purposes including space exploration and commercial applications.

Examples. "Space should never be militarized." (DC_E0011), "No weapons in space!" (DC_E0024), "I support the "No Action" alternative to missile defense systems, especially those that would utilize space." (DC_E0036), "Please stop the militarization of space now." (DC_E0038), "The planet, the human race, all of life on this unique place called Earth cannot survive one country's global dominance from space or the use of nuclear weapons from anywhere. I fear this is simply another scheme to make a few people rich -- the corporations who get the contracts, the corporations who benefit from mining the moon." (DC_E0055)

Response. Alternative 1 would not include the use of space-based weapons while Alternative 2 would include the use of weapons from space-based platforms. While this PEIS considered two implementing alternatives for the BMDS, this PEIS performed an environmental analysis, not a policy analysis of the alternatives. The comments that were collectively summarized and grouped as *"Opposed to Weapons in Space"* were comments that expressed a philosophy, value, or opposition to an action. These comments were not substantive comments on the scope of the *environmental analysis* in this PEIS regarding the use of space-based weapons but rather statements against the *policy* of using space-based weapons. These comments appear to fit within the definition provided for non-substantive comments, i.e., comments that express a philosophy, value, or support or opposition for an action; therefore, it would appear to be appropriate to include them in this grouping. These types of issues are not part of the decision to be made in this environmental analysis. Therefore, these comments were determined not to require a substantive reply.

Other commenters may have provided substantive comments on the use of space-based platforms either as they relate to debris production or other issues of concern. These comments will be addressed as part of Section K.4 of this Appendix.

K.3.13 BMDS Does Not Defend Against a Realistic Threat or Provide Safety for the U.S.

Summary. Several commenters expressed that the development of a BMDS would not defend against a realistic threat or provide safety for the U.S.

Examples. "The prospect of having weapons in space threatening anyone on earth will not enhance our security, but rather further destabilize our relations with other nations…" (DC_E0039), "Furthermore, the construction of such a system is liable to increase the danger to our own country by goading potential enemies to build bigger and better missile systems of their own." (DC_E0096), "The proposed system will promote a false sense of security…" (DC_PHO0027), "…[the BMDS] would not offer any protection for a more likely sea-platform launched attack." (DC_E0180), "Anyone serious about protecting the United States, not to mention other people in the world, would be making some effort to reduce the global spread of weapons, especially these weapons of mass destruction which don't even have a real world threat against which to defend." (DC_E0182)

Response. These types of statements are the opinion of the commenter and are thus not appropriately addressed in an environmental analysis. Therefore, comments concerning the ability of the BMDS to defend against a realistic threat or provide safety for the U.S. were determined to be outside the scope of the BMDS PEIS and do not require a s

K.3.14 Realistic Testing Should be Conducted Prior to BMDS Deployment

Summary. Several commenters expressed that realistic testing of BMDS components should be conducted prior to deployment of the BMDS.

Examples. "…should the decision be made to pursue the program that a more realistic testing program be developed and carried out as a part of the development program." (DC_E0156) "I urge everyone concerned to halt all missile defense system deployment until realistic testing is completed and the system is demonstrated to be very successful under realistic conditions, including likely countermeasures such as decoy targets." (DC_E0440) "The worse aspect is the rush to deployment before components have been tested fully." (DC_M0001)

Response. This PEIS considers the environmental impacts from possible realistic testing scenarios that could be used to test the BMDS. However, this environmental analysis is not the appropriate venue to determine the outcome of testing and thus to determine when or how to deploy an integrated BMDS. Therefore, comments concerning deployment of the BMDS only after successful realistic testing were determined to be outside of the scope of the BMDS PEIS and do not require a substantive reply.

K.3.15 Generic Comments on Environmental Issues

Summary. Several commenters presented general concerns about the potential environmental impacts associated with the development, testing, deployment, and decommissioning of the BMDS. Comments that were identified under this category tended to be statements of opinion and were not supported by scientific evidence or were not specific comments on the analysis presented in the PEIS.

Examples. “In considering the Environmental Impact of the proposed BMD system, the PEIS should address the full extent of possible environmental impacts on our planet and the proposed surrounding outer space intended field of operations” (DC_E0424), “Even if MD does work, the likely health and environmental consequences of the fallout from an intercepted missile (potentially with a nuclear, biological or chemical warhead) being dispersed over populated areas render the system unacceptable.” (DC_F0007), “Deployment of such a system threatens a new nuclear arms race, puts the global environment at risk, and does not improve the security of the United States.” (DC_E0343) “Deployment of the Bush administration’s proposed missile defense system threatens the global environment.” (DC_M7903)

Response. Many of these general or non-specific environmental issues are considered in the PEIS. Some resource areas including Cultural Resources, Environmental Justice, Land Use, Socioeconomics, Utilities, and Visual Resources are more appropriately considered in site-specific environmental documentation. Each of these was discussed regarding methodology and thresholds for significance to provide a “roadmap” for performing future site-specific analyses tiering from the PEIS. The following resource areas were considered in the PEIS: Air Quality, Airspace, Biological Resources, Geology and Soils, Hazardous Materials and Hazardous Waste, Health and Safety, Noise, Transportation, Water Resources, and Orbital Debris.

The PEIS analyzes the environmental impacts of the implementation of the BMDS under Alternative 1 in Section 4.1.1, this includes the use of weapons, sensors, C2BMC, and support assets for all of the resource areas described above. The environmental impacts of Test Integration under Alternative 1 are analyzed in Section 4.1.2. The impacts of activities at Locations Outside the Continental U.S. are discussed in Section 4.1.3. The cumulative impacts associated with Alternative 1 are considered in Section 4.1.4. The environmental impacts associated with Alternative 2 are addressed in Sections 4.2.1 Impacts Analysis, 4.2.2 Test Integration, and 4.2.3 Cumulative Impacts. The impacts of the No Action Alternative are addressed in Section 4.3.

K.3.16 “Voting” for Alternative 2

Summary. Commenter indicated support for Alternative 2 as presented in the BMDS PEIS.

Examples. “I would encourage our government to continue research and development of a space based weapons system or systems based on the needs of the United States as outlined by the Joint Chiefs of Staff.” (DC_E0353)

Response. Please see response to K.3.7.

K.3.17 In Favor of BMDS

Summary. A few commenters stated that they were in favor of the testing and/or development of missile defense technologies including those proposed for the BMDS.

Examples. "I am writing today to support the the [sic.] deployment of the missile defense system." (DC_M7808), "I believe we should have a limited missle [sic.] defense system capable of defending the USA and our allies from a small scale missle [sic.] attack (50 or fewer missles [sic.]." (DC_M7712) "I am writing today to support the missle [sic.] defense system." (DC_M7739), "Therefore, I fully support the Bush Administration's plans for missile defense." (DC_M7843)

Response. As stated in Section 1.2 of the Draft BMDS PEIS, on January 2, 2002, Secretary of Defense Rumsfeld issued a directive to the DoD to establish a single development program for all the work needed to design, develop, and test elements of an integrated BMDS that would operate under a newly titled MDA. Therefore, it has been determined that a BMDS should be developed. This PEIS considers the environmental impacts of various implementing alternatives for such a system. Therefore, comments expressing a favorable opinion of the BMDS and other related policy issues were determined to be outside the scope of this environmental analysis.

K.3.18 Miscellaneous Issues or Topics

Summary. Several commenters provided comments that were determined to be on issues or topics that did not pertain to the BMDS. These comments were determined to be out of scope. Examples of these comments are provided below.

Examples. "Likewise destroying the population of the earth through AIDS Ebola, SARS, Anthrax, Chemtrails, lethal drugs, deadly vaccines programmes, fluoridation of water, etc should also be halted forthwith." (DE_E0198), "…We have programs now that have technology that can actually change the way that we think. We have to choose that. It's a choice we have to make. But we can actually change from a victim mentality to a very powerful mentality in taking responsible for our actions. This kind of technology is also available in Israel and practiced on a regular basis all over the world through a program called Landmark Education. There is also a program called the HeartMath that teaches thinking through the heart, as opposed to strictly through the head…." (DC_PHO0034) "…In a little joke on the refrigerator where a man is standing on stage and he's asked to play a concerto. He says, "Don't make me come down there" to the audience. I'm going to go down there. I don't know how successful I will be. But maybe if everybody who lives in Sacramento will call Mr. Mort Salisman and leave messages on his machine and ask him why nobody was here and why Channel 3 and Channel 10 didn't come either. I don't know what they're doing but I know -- I don't know. I don't think so because they checked the list…." (DC_PHO0035) "…The World's first thermonuclear

device utilizing hydrogen fusion, a project code-names Mike, was detonated on Enewetak in 1952…." (DC_PHW0012)

Response. Because the subject matter of these comments did not pertain to the BMDS they were determined to be out of scope or non-substantive and are therefore not considered further.

K.4 In Scope Comment Documents

Comment documents that contained substantive comments that were determined to relate to the scope of this PEIS were identified.[3] These comment documents are reproduced in Section K.4.1. In general, comments that addressed the resource areas analyzed in the Draft BMDS PEIS, feasible alternatives, relevant laws and regulations, and specific comments relating to the impacts analysis, were considered in scope. Responses to in scope comments are provided in Section K.4.2. Section K.4.2 includes the comment document number and sequential number of the comment, the resource area addressed by the comment, the text of the comment, and MDA's response. Where appropriate, revisions to the Final BMDS PEIS were made in response to these comments. Note that the names and addresses have been removed from the reproductions to protect the privacy of the commenters.

K.4.1 Reproductions of Comment Documents Containing In Scope Comments

[3] Note: responses to comments from Federal agencies are provided in Section K.5 of this Appendix.

DC_E0030

Johnson, Kathryn

From: Dwight Rousu
Sent: Wednesday, September 22, 2004 12:23 AM
To: mda.bmds.peis
Subject: MDA BMDS PEIS

1) The new Star Wars program as outlined in the PEIS will be destabilizing thus creating new momentum to move the deadly and dangerous arms race into the heavens. This will create more global instability and nuclear materials accumulation and contamination around the world.

2) Testing and deployment of weapons in space will create massive amounts of new space debris making the environment of space even more contaminated and thus unavailable for future space flight.

3) This new Star Wars plan will be extraordinarily expensive requiring massive cuts in environmental clean-up of other problems, with the many drastic environmental impacts that would cause.

4) The likely use of nuclear power for eventual space-based weapons would be a long term environmental disaster.

5) Space-based weapons, described in the PEIS as being "defensive", could easily serve an offensive purpose as outlined in the Space Command's Vision for 2020 that says the U.S. will "deny" other nations the use of space.

6) Toxic rocket exhaust pollution is now contaminating the Earth and punching a hole in the ozone layer. This plan would dramatically expand these polluting launches.

7) Offensive tactics such as new decoys, maneuvering warheads, concurrent high altitude nuclear bursts to disable sensors, all make the probability of complete success of the BM defense almost zero.

8) Unless the offensive missiles are sensed on launch and destroyed during boost, the dirty bomb effects will rain on the targets anyway; and the proposed system is not designed to intercept during boost.

9) Other offense delivery mechanisms like suitcases in a shipping container, were not addressed, and would probably be more effective.

DC_E0030

10) The environmental effects of the X-band radar upon people and birds have not been thoroughly studied.

11) The conservative cultist and Republican affectionado, Sun Myong Moon, has helped the North Koreans obtain submarines; so the launch points and trajectories for which the system was planned can be circumvented, yielding the system worthless.

12) Shifting alliances and politics may make Russia, China, India, Pakistan, or any of several middle east countries more of a threat than North Korea. Alternatives to world-ending war mistakes are needed, not infinite arms building around the world.

13) For all these reasons I support the "No Action Alternative."

Dwight Rousu

I would rather live with uncertainty than with answers that are wrong. (from Feynman)

DC_E0142

Johnson, Kathryn

From: michael ibison
Sent: Sunday, October 31, 2004 12:47 AM
To: mda.bmds.peis
Cc: ucs@ucsusa.org
Subject: public comments on national security utility of ballistic missile defense system

Dear Sir / Madam

I request that the following be added to the record of public comments as part of the initial assessment of the feasibility of the proposed ballistic missile defense system currently under consideration by the present (Bush) administration.

My credentials are that I have a Bachelors in Electronics and a PhD in physics. I spent 10 years in automatic image analysis, and have authored several publications and some patents in that field - in addition to papers I have authored in physics. A large part of that 10 years was spent working for a defense company, some of which on a DARPA project, developing automatic image analysis with potential applications for intelligent weapons guidance. I was awarded a research scholarship at Princeton University, and currently work for a non-profit research institute in Austin, Texas.

In the following, the term `image' applies to any time-evolving 2D array of data captured by optical, infra-red, and microwave sensors.

Very briefly, it is my perception that the state of the art in automatic image analysis is such that reliable object recognition is possible only in well-controlled environments wherein the quiescent illumination, the clutter, and preferably the orientation of the target object are under control. These environmental constraints obviously cannot be imposed on a ballistic missile defense system, and therefore one should be very skeptical of claims that enemy missiles can be reliably identified. To the extent that the proposed system depends on automatic detection of enemy missiles, it is very unlikely that it will be reliable, given the present state of the art.

No doubt more reliable methods will be developed in future. But I urge an honest evaluation of the current test data, and realistic assessment of possible future improvements, uncorrupted by commercial and political influences.

Yours Sincerely,

Dr. Michael Ibison

DC_E0158

Johnson, Kathryn

From: Arne Soderman
Sent: Thursday, November 04, 2004 6:28 PM
To: mda.bmds.peis;
Subject: Public Comment on Space based missle defense system

To whom it may concern:
My name is Arne Soderman. I'm working and living in Portland, OR. After reviewing this plan for a space-based missle defense system I have criticisms that are not remedied by any option you've given the public. Of the three choices, I am compelled to support the "No Action (#3)", as it is the least destructive to the environment.

Acquiring the necessary materials, construction, and especially deployment of these systems into space are uneqivocally harmful. Rockets emitting a plethora of chemicals, continue to punch holes in our thinning ozone layer; and that which falls to the earth poisons our groundwater and rivers (perchlorate). Intensifying this for enemies non-existant (for no good reason) would be pointless destruction.
Larger objects that return to earth, or stay in orbit present problems as deadly space litter travelling at thousands of miles per hour, or hundreds as they strike the earth. Space litter has already killed (when Mir was left to gravity) and more only increases the chances of the loss of human, animal, and plant life as objects fall where they may.

The detonation of these weapons destroys the environment in a way that makes the above concerns seem silly. Nuclear winter is the end of human kind.
When we threaten others with nuclear devices, we are responsible for the nuclear devices that they come to possess. When we detonate first, that which happens as a result is also our responsibility. This missle defense system is advancing the world towards nuclear proliferation. We should abandon all weapons nuclear, and return to the United Nations Disarmament Treaty process. I can't support anything but a True "NO ACTION".

sincerely
Arne Soderman

DC_E0162

Johnson, Kathryn

From: Michael Jones
Sent: Friday, November 05, 2004 1:46 PM
To: mda.bmds.peis
Subject: comments on the draft BMDS PEIS

5 Nov. 2004

via E-mail to: mda.bmds.peis@icfconsulting.com MDA BMDS PEIS c/o ICF Consulting 9300 Lee Highway Fairfax, VA 22031

Below are my comments on the draft Programmatic EIS (PEIS) for the Ballistic Missile Defense System (BMDS). Some of the PEIS deficiencies could be fixed by changes to the draft but this document comes so late in BMDS development and testing that it is largely irrelevant. Section 1.2 shows that environmental analyses have already been done for most components; notable exceptions are Aegis BMD and space-based weapons.
Development and testing of most components are well underway and decisions about initial deployment of GBI's and Aegis BMD ships have been made. The spiral development process which, according to the PEIS (page ES-7) allows MDA to "consider deployment of a missile defense system that has no specified final architecture and no set of operational requirements,"
seems to preclude any meaningful assessment. The PEIS could make a useful contribution by analyzing how to judge the effectiveness of a system with no operational requirements.

Another major general deficiency is that the No Action alternative is not considered seriously. It is asserted on page 2-67 that it "would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress." Footnote 19 on page
1-6 quotes the part of the 1999 Missile Defense Act which declares a policy to "deploy as soon as is technologically possible an effective NMD system." It is noted on page 1-6 that Pres. Clinton decided in Sept. 2000 not to authorize deployment of an NMD system for reasons including technical uncertainties and unsuccessful flight tests. Two GAO reports in
2003 and a Union of Concerned Scientists report Technical Realities in May
2004 raise serious questions about the readiness for deployment of current NMD components. Therefore, it seems that the No Action alternative (which was essentially U.S. policy until 2002) is preferable until one can demonstrate that an "effective" NMD is "technologically possible." The most recent NMD intercept attempt failed on 11 Dec. 2002, six days before Pres. Bush announced that the U.S. would deploy an initial NMD system. The test results so far and independent analyses suggest that it is at least questionable whether an effective NMD system is possible.

Detailed comments follow.

1) The PEIS should give quantitative information on the reliabilities of the boosters to be used to launch targets for BMDS tests. I noted in my scoping comment (See first comment on page B-15 of the draft PEIS.) that I had asked for this information in my comments on the 1994 BMD draft PEIS and that the response was inadequate for any meaningful assessment of the risks from launch failures. This information is especially important to include in the PEIS because the same target boosters are used in various test programs and because the information has not been included in previous environmental analyses. I noted in my comments on the 2003 GMD ETR draft EIS that an analysis of Minuteman test launches found a rate of severe failures of 15% and that the Strategic Target System has had one serious failure
(9 Nov. 2001 launch from Kodiak) in five launches. Including my scoping comment in exhibit B-9 as a health and safety issue seems to imply that this aspect should be analyzed in the PEIS. At the 26 Oct. public meeting in Honolulu, I was assured that including booster reliability information would be considered.

2) The PEIS should examine in detail treaty compliance of various BMDS tests. The draft

PEIS has no discussion of INF Treaty restrictions on long-range air-launched and sea-launched targets or START Treaty restrictions on sea-launched targets even though I raised this issue in my scoping comments. (See fourth comment on page B-15.) The GMD ETR EIS did not consider treaty compliance despite the fact that previous analyses
(1994 TMD ETR EIS and 1998 TMD ETR Draft Supplemental EIS) did consider this issue. The 1994 TMD ETR EIS refers to the INF treaty prohibition of air-launched and sea-launched missiles with ranges between 500 and 5,500 kilometers. The 1998 TMD ETR DSEIS notes that the START treaty prohibits launches from sea-based platforms and that launches from ships are restricted to ranges less than 600 kilometers. If subsequent compliance reviews of air-launched and sea-launched targets have been done, they should be discussed in the PEIS and references to them should be cited.
I was assured at the 26 Oct. meeting in Honolulu that this would be considered.

3) The PEIS discussion of cumulative impacts in section 4.1.4 and Appendix I has no details about the location, schedule, and specific missiles to be used for the estimated 515 launches from 2004 to 2014. This is important because there are annual limits on the numbers of launches at the Pacific Missile Range Facility (PMRF), Kodiak, and Vandenberg AFB, as noted in the GMD ETR EIS. The GMD ETR EIS estimated 10 launches per year so the PEIS needs to give some details about the additional 415 launches. Some information about future launches for tests of some BMDS components is provided in Appendix D. However, there are no estimates for Aegis BMD tests and only vague estimates for GMD tests. For example, it is stated on page D-25 that, "GMD test plans include a number of missile-launches (interceptors and/or targets) from each launch facility per year." The PEIS should also include impacts of test launches of offensive missiles.
For example, tests of the Trident D5 are reported to be planned near PMRF in 2005.

4) Page D-15 of the PEIS contains misleading information about previous NEPA analyses related to Aegis BMD. It cites the 1998 PMRF Enhanced Capability EIS as a supporting NEPA analysis. In fact, this EIS explicitly excluded the Navy Theater-Wide System (now called Aegis BMD) from evaluation. No subsequent environmental analysis has been done even though Aegis-LEAP tests have been done near PMRF. The PEIS should indicate when environmental analyses of this system will be done. Press reports have indicated that 20 sea-based midcourse interceptors are scheduled for deployment in 2005. The PEIS states on page D-19 that three Aegis BMD cruisers and 15 Aegis BMD destroyers would be available for deployment at the end of Block 2004.

5) The PEIS has no discussion of the unresolved safety issues involving Strategic Target System and THAAD launches at PMRF which I noted in my scoping comments (second comment on page B-15). No detailed hazard areas have been shown for Strategic Target System launches at azimuths other than 280 degrees. Similarly, no diagrams showing the THAAD hazard area were given in the 2002 THAAD EA and no detailed analysis was cited to justify the reduction in the hazard area radius from 20,000 feet in the
1998 PMRF EIS to 10,000 feet in the THAAD EA. There can be no meaningful public evaluation of the risks of such launches without this information.

6) The PEIS contains a short discussion of future laser weapon systems (page F-7) and the Tactical High Energy Laser (page F-9). It notes that testing of a laser demonstrator began in 2000. The PEIS should review these tests and testing plans for other high-power laser weapons and other directed-energy weapons. An article in the 18 Dec. 2002 Jane's Defence Weekly indicated that a megawatt-class free-electron laser could be tested at PMRF in two to three years.

7) In addition to "hit-to-kill" interceptors and directed-energy weapons, there have been reports that interceptors armed with nuclear weapons are also being considered for missile defenses. The PEIS should indicate what research and development work is being planned for such weapons as part of the Advanced Systems in Appendix F. How would such systems be tested without violating the Limited Test Ban Treaty and the Comprehensive Test Ban Treaty?

8) In 2002 the Defense Dept. announced that it would classify details about missile defense tests that had previously been public information. How can the public and independent technical analysts assess the impacts of tests and judge the effectiveness of BMDS components if this information is unavailable? Similarly, how can one estimate the impacts of entirely secret programs?

9) There are egregious errors in Exhibit 4-11 on page 4-102. There is an addition error

in the line for HCl emissions. The more serious error is that the total emissions of 115 kilograms for the representative interceptor is too small by a factor exceeding 100. Table 4.1.1-8 of the
2003 GMD ETR Final EIS gives total stage 1 exhaust emissions of greater than 15,000 kilograms. The GBI analyzed in that EIS had a total propellant mass of 19,767 kilograms of which 15,069 was in stage 1. The PEIS notes on page D-20 that each GBI may contain up to 20,500 kilograms of solid propellant. Exhibit 4-11 should be corrected; the information for BMDS launches in Exhibits 4-13, 4-14, and 4-15 may need correction if it is based on the interceptor data in Exhibit 4-11.

10) The brief history of U.S. missile defense activities in section 1.2 excludes any mention of critical technical analyses of components and testing of them. For example, the 1998 report of the Pentagon panel headed by Gen. Welch characterized the inadequate preparation for flight tests as a "rush to failure." Two GAO reports in 2003 (GAO-03-441 and GAO-03-600 available at www.gao.gov) questioned the adequacy of testing and readiness for NMD deployment. The May 2004 report Technical Realities (available at www.ucsusa.org/global_security/missile_defense/index.cfm)
by the Union of Concerned Scientists provided a critical analysis of the NMD system being deployed. It is noted on page 1-7 that Pres. Bush's
17 Dec. 2002 decision to deploy an initial defense capability followed "continued test bed development and successful flight test activities."
It should be added that this decision followed by six days a test failure and that the test record so far is five intercepts in eight attempts.

11) The brief history of the Lightweight Exoatmospheric Projectile (LEAP) program on page D-17 states that tests in the early 1990's showed that LEAP "could be integrated into a sea-based tactical missile for ballistic missile defense." In fact there were no successful intercepts in five attempts in these tests. Two successful Aegis LEAP intercept tests in 2002 are described but there is no mention of the intercept failure on 18 June 2003.
The Aegis LEAP test record so far is four intercepts in five attempts.

12) It is stated on page D-40 that there were eleven THAAD flight tests in the 1990's and that, "Upon successful intercept, the THAAD program began planning to validate the performance capability and overall effectiveness of the THAAD element, flights tests, and intercepts of target missile launches over more realistic distances..." Of the eight intercept attempts in the 1990's tests, there were only two hits.

13) The example test scenario on page 2-13 involves use of the Cobra Dane radar. However, the August 2003 GAO report GAO-03-600 noted that there were no plans to test this radar using BMDS targets. Are such tests now planned in the next ten years?

14) The details of integrated flight test events are characterized as "only conceptual at this time" on page 2-50. Some test scenarios examined in the
2003 GMD ETR EIS had jet routes between Hawaii and the West Coast crossing the target and interceptor debris areas. What details about these tests will be made available for public evaluation?

15) Section D.2 has a brief discussion of land-based and sea-based Kinetic Energy Interceptors (KEI) for use as possible components of a boost-phase defense. It should be noted that a study of possible boost-phase defenses -- including surface-based and space-based KEI -- found that they would have limited capability against liquid-fueled ICBMs and were unlikely to be practical against solid-fueled ICBMs. This study was done by an American Physical Society study group and was released in July 2003. It is available at
www.aps.org/public_affairs/popa/reports/nmd03.cfm

Please acknowledge that you have received these comments.

Michael Jones

DC_E0179

Johnson, Kathryn

From: larry ebersole
Sent: Monday, November 08, 2004 2:46 PM
To: mda.bmds.peis
Subject: PEIS Comments Corrected Version Please Use Only This Copy

Note from Laurence H. Ebersole: This is my corrected comment. Please disregard the previous one sent today. I was misinformed about Alternative Three being a no project alternative. Rather, I want to point out that the entire project is Flawed and should be Halted (alternative three merely continues the existing programs without halting them).

Laurence H. Ebersole

November 8, 2004

Dear Consultants:

RE: Comment on Ballistic Missile Defense System.

As I understand the situation, public comments are invited to help with the review of the proposed, Ballistic Missile 'Defense' System.

I believe that halting the project is the best option.

My concerns are both substantive and technical. First my substantive concerns.

I) I think, the World Court Decision of 1996, along with customary international law, and binding treaty, all require that the United State's along with all stated nuclear powers, disarm nuclear weapons; not build more, or make technological shields against the use of nuclear weapons. Goals, and specifics for this nuclear disarmament can be resolved without further delay, since the ground work is already part of the history of arms control, and disarmament agreements.

Therefore, to implement, for instance, Article IV of the Nuclear Non Proliferation Treaty, and to completely ratify the Comprehensive Test Ban Treaty, are a best shield against nuclear weapons ever being used, or the thereat of use of these weapons. Please remind the proponents of this weapons system to uphold these international agreements. Please do not violate these agreements by constructing, planning to construct, the proposed missile 'defense' systems.

II) Technologically, the concept of a missile defense is flawed for an Anti-Missile Missile System. The system can be used as a first strike system, and be viewed this way, thus, contribute to weapons proliferation. The system will drain public funds further away from humane uses like higher education, social rehabilitation, environmental cleanup, child care, health care -- the economic, social, and cultural

DC_E0179

human rights asserted in the Universal Declaration of Human Rights (Articles 23 & 25 among others). The system is not needed and is a "pork" program for the profits of the weapons makers. The system contributes to pollution and greater atmospheric ozone destruction, at a time when the impacts of global warming are reasons to be concerned. The system involves radionuclide's and nuclear elements which are toxic, and themselves can burn and potentially causes public health problems.

Conclusion: Please implement a Halt to all further development to design, building, planning, deployment, of a first strike weapons system known as the Anti Missile Missile System (the ballistic missile 'defense' system).

Yours Sincerely

Laurence H. Ebersole
Writer & Counselor

cc: Congressman McDermott

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DC_E0186

Johnson, Kathryn

From: Paige Knight,
Sent: Monday, November 08, 2004 6:40 PM
To: mda.bmds.peis
Subject: PEIS on the Balistic Missile Defense System: Public comment

Hanford Watch
November 8, 2004

I am commenting on behalf of our organization on the Alternatives being proposed by the government on continuing on with the building of the BMDS as well as choosing from among your proposed options.

We are against all of the proposed alternatives, including the No Action Alternative for the following reasons.

First, this program so far as produced few results for the incredible amount of taxpayer dollars that have been spent since Reagan's Presidency. Much of the thinking behind this pork project has been based on flawed premises and illusions of grandeur by the people who are getting rich off the scheme.

Second, this PEIS is supposed to show the impacts of this project on the environment. According to your charts the impacts will be great on our water, which is becoming a scarce resource (that is, clean water, drinkable water), on our air which is already a hazard to human health for all living creatures and in particular for the children of the planet--the future generation and on the earth in the places it is being built. There will be horrendous impacts from the debris that is left in space and will eventually affect the planet It will impact the oceans and the species that inhabit the ocean. Nuclear power will be used in this project and we to date and in the future have no way to protect ourselves from the extreme and long-lasting hazards of the waste. Yucca Mountain and WIPP will hold only a small portion of all the commercial and defense waste that exists now, not to mention all that will be created in the future by programs of the defense department. It will further degrade the land which sustains us.

Third, this project will further destabilize the globe, which seems to be part of the intent. This program will not save us from terrorists who have no need of the sophisticated weapons that this "shield" is to theoretically protect us from. This program fosters an arms race as well as weapons proliferation rather than deterring other nations or "enemies" from competing with us. . It is part of the double standard by which our government and the defense department operate, only making the world a far less safe place. The real intent of the program according to some of your own documents is to take control of the world by space, land, sea and air as the gulf widens between "the haves and the have not's"--a gamut of policies planned by a group of the administration that is in power at this time.

Finally, this project has and will continue to squander our precious resources, especially our money, our tax dollars while education systems flounder, health care becomes a luxury only for the rich (while we all have our health placed in more jeopardy by such projects. We are living under an incredible deficit which our children will not even be able to make a dent in and will continue on the road to becoming a third world country.

DC_E0186

To continue on with this project as would be the case even under the "no action alternative" is unconscionable. We believe that even if you were to re-do the PEIS, there would be no reasonable alternative other than shutting down the project and calling it the loss it already is.

Sincerely,

Paige Knight, President

DC_E0204

Johnson, Kathryn

From: Rosalie Tyler Paul
Sent: Tuesday, November 09, 2004 9:45 AM
To: mda.bmds.peis

It is my understanding that Alternative 3 means "no change" so that all programs continue as planned. This is not acceptable. The statement must be rewritten to allow for a true "no action" choice....meaning NO R&D or Production of the missile defense program, no weapons in space!

Rosalie Paul, Georgetown, Maine

The PEIS considers three options:

Alternative 1, missile defenses without space-based weapons.
Alternative 2, missile defenses with space-based weapons.

Alternative 3, no action.

DC_E0211

Johnson, Kathryn

From: wfudeman
Sent: Tuesday, November 09, 2004 4:38 PM
To: mda.bmds.peis
Subject: Missile Defense- Rewrite entire PEIS, please. stop funding Star WArs

The PEIS must be rewritten, because the "No action" alternative is insufficient. The most appropriate choice is to stop all funding of Star Wars Missile defense.

The extraordinary expense of this program is inexcusable, and should be discontinued. The entire program will do far more harm to the entire world and US security than if it were discontinued.

To develop missile defense at this level will move the arms race to space, and will destabilize an already unstable world.

The use of nuclear power to propel the missiles and the likely debris we would be releasing into space is environmentally, a disaster.

I want no more of my tax dollars to support this foolish program. Please rewrite the PEIS to allow the sanest alternative- scrapping this program entirely- to be a choice. The best choice.

Thank you.

Sincerely,

Will Fudeman

DC_E0216

Johnson, Kathryn

From: Doctress Neutopia
Sent: Tuesday, November 09, 2004 2:19 PM
To: mda.bmds.peis
Cc: Doctress Neutopia
Subject: Comments of Star Wars

To whom it may concern:

The night sky is a beautiful sight. It brings a sense of wonder and awe for a universe our species is only beginning to know. There is so much we don't know, but one thing we better learn quick is how to live in peace. Going ahead with Bush's Star Wars plan brings war and nuclear power into Outer Space. It makes other nation-states afraid of what the US might do. It could start another Cold War. Anyone with a heart and knowledge of science knows that bombs in Outer Space is a violation of the life force.

Deployment of these new weapons litters the atmosphere with space junk, just what we don't need in a world that already doesn't know how to recycle most of its rubbish. When people around the planet are starving and homeless, why spend an extraordinarily amount of money on a program that helps nobody? The flumes from the fuels only comes back to Earth and makes us sick. Isn't it time we wised up and stopped killing ourselves?

For all these reasons I believe the "No Action Alternative" is insufficient and the entire PEIS should be rewritten.

Doctress Neutopia
Libby Hubbard, EdD

DC_E0231

Johnson, Kathryn

From:
Sent: Wednesday, November 10, 2004 8:38 AM
To: mda.bmds.peis
Subject: Star Wars

Mary West

The definition of no action to me is to STOP WHAT IS NOW BEING DONE!!!

DC_E0233

Johnson, Kathryn

From: Anne Brotherton
Sent: Wednesday, November 10, 2004 9:46 AM
To: mda.bmds.peis
Subject: NOT ACCEPTABLE!

None of the three options for PEIS is acceptable! The third is the most dangerous because it is so deceptive, meaning "business as usual." Let's scrap this entire frivilous program and get on with the vital business of remediation of the mistakes of the past four years and prevention of more of the same during the second Bush administration.

Anne Brotherton

DC_E0262

Johnson, Kathryn

From: Don Stephens
Sent: Thursday, November 11, 2004 3:44 PM
To: mda.bmds.peis
Subject: MDA BMDS PEIS comments

To Whom It May Concern,
I am writing in opposition to the three options of the MDA BMDS PEIS, including the No Action option, since it is in reality not a true No Action as it includes continued development of interceptors.
I urge you to revise these options with more concern for the environmental damages that will result from these actions.
Thank you.

Don Stephens

DC_E0270

Johnson, Kathryn

From: Paul Cunningham
Sent: Thursday, November 11, 2004 8:44 PM
To: mda.bmds.peis
Subject: why no?

Stop the madness!!! We do not need weapons in space. That would only create an entirely new arms race. If selling weapons is all one cares about this is the goal. It has been agreed internationally to use the heavens for only peaceful endeavors. Common sense reveals many problems here on earth that need attending to, and with our government already overspent it makes no sense. the biggest concern is that this "defense" system is just another offensive weapon, adding to our already illegal slant toward preemtively blasting whomever we say is the criminal of the day. How do we know of this intent? because the defense missiles have failed all attempts to hit other missiles, the only answer is that someone wishes to have space-strike capability.

The"No Action Alternative" is insufficient and the entire PEIS should be rewritten.

No nukes in space!!!!!!

Paul Cunningham

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DC_E0319

Johnson, Kathryn

From: cheitman
Sent: Monday, November 15, 2004 1:40 AM
To: mda.bmds.peis
Subject: Oct. 14, 2004 BMDS Draft PEIS Comments

Carolyn Heitman

October 14, 2004

Sent E-mail to: mda.bmds.peis@icfconsulting.com

Enclosed are my comments on the BMDS Draft PEIS.

The MDA did a very poor public relations job in regard to getting the word out on the availability of the Draft PEIS and on the October 2004 public hearings in what will be the affected BMDS test communities. The public cannot make comments on something they do not know exists if it is not well advertised in advance (e.g. notices in newspapers). Holding public hearings in Anchorage, Alaska when the BMDS test site is located on Kodiak Island, Alaska, and in Sacramento, California when the test site is at Vandenberg AFB near Los Angeles, showed the MDA's intent was to make it as difficult as possible for members of the public to travel to the meeting places to testify and give their comments on the Draft PEIS. The MDA put a public notice in the Kodiak Daily Mirror and sent a copy of the Draft PEIS to the Kodiak Island Borough's office only after being urged by local residents. Otherwise, local officials and community members would not have known of its existence. This repetitive MDA behavior is unacceptable.

Some of the issues I wanted to see addressed by the MDA which I listed in my June 7, 2003 comments on the Notice of Intent to Prepare a PEIS for the BMDS were:

(1) Whether or not any *low-yield nuclear material* will be used in the BMDS test systems (boosters, payloads, dummy warheads, satellites, interceptors, targets, radar systems)
(2) Whether or not any *low-yield nuclear material* will be stored at Research Development Test Sites
(3) If *depleted uranium* will be used in/on target missiles, interceptors, satellites, boosters, etc.
(4) If *depleted or spent uranium* will be stored at Research, Development Test Sites
(5) A listing of the Test Sites where target missiles will be launched to be intercepted by the Airborne Laser
(6) Include detailed information on *High-Powered Microwaves* ('Directed Energy') will be used as part of the BMDS and the environmental hazards associated with their transmission into the atmosphere and ionosphere (include human Electromagnetic Radiation (EMR) hazards)
(7) If missiles are being proposed for launch from Fort Greeley, Alaska
(8) Information on proposed BMDS launches from Poker Flats Rocket Range, Alaska

None of the above issues were clarified or answered in the Draft PEIS, so once again-- I am requesting the issues be addressed.

NOTE: Regarding Fort Greeley, Alaska-- is the MDA proposing to launch future 'interceptors' in a 'north trajectory' (or south trajectory), over Alaska native villages from that location? If so, the PEIS should list all safety drop-zones for falling booster stages and proposed trajectory launches, along with what safety steps will be taken to protect natives in their villages. Also include potential cumulative environmental damage to the tundra from falling boosters.

The MDA has never referenced or included discussion on the **INF Treaty MOU** in any previous Ea or EIS in regard to missile defense testing, nor is it discussed in the BMDS Draft PEIS. *Why not? Why is the MDA avoiding*

DC_E0319

this issue? Nor has the MDA referred to or listed the Research and Development test site locations in Alaska on the INF Treaty MOU list (e.g. Kodiak Launch Complex, Alaska and Poker Flats Rocket Range, Alaska). The MDA's avoidance of discussion on these test launch sites, leaves open the question as to whether or not *nuclear material* can and *will* be launched from these test-site locations on future targets, interceptors, boosters, dummy warheads or used in laser systems. The PEIS *should* include information on the INF Treaty, the INF Treaty MOU test locations, plus any proposed future plans to use nuclear material as part of ground-based or space-based BMDS testing. The MDA is projecting test plans up to the year 2014, so it already knows if nuclear material is part of the BMDS test system (power for space-based platforms, lasers, etc).

There has not been an environmental assessment since 2001 (that the public is aware of) regarding the reliability of the STARS missile to justify the continuation of this launch vehicle. The November 2001 STARS launch from the Kodiak Launch Complex resulted in failure (the missile 'exploded' 7 miles off Kodiak's shores after launch and the MDA attempted to cover up the accident). No public reports were released on this launch failure. The STARS missile has not been improved since the early 1990's launch failures from Kwajalein Atoll. This program should be discontinued due to its unreliability, safety hazards, and pollution to air and water.

The BMDS Draft PEIS discusses ground testing of 'portable' lasers, but does not list all the potential test sites. A September 2004 ABC news report stated a Delta Airlines pilot received an eye injury when a laser beam came through the cockpit window on his approach to the Salt Lake City, Utah airport. There have been no further reports regarding where the laser beam originated; However, it leaves open the possibility of whether some ground-based or air-based laser tests were going on at the High Energy Laser Systems Test Facility located at the White Sands Missile Range in New Mexico and the Delta Airlines pilot happened to get caught in the laser's crossfire. Utah and New Mexico are within close proximity in air miles. As stated in the Draft PEIS (Volume 1, page 4-21 thru 4-34), environmental and human health hazards would result from testing air based and ground based 'portable' lasers, which is: cancer causing chemical releases into the air and waters, potential skin burns and retina damage from laser beams and/or laser 'scatter', hazards to commercial and other aircraft, birds, plants and wildlife. "Hydrochloric acid produced as a result of the interaction between laser emissions and moisture in the air has the potential to produce impacts on biological resources, including plants and aquatic animals, and water quality" (Draft PEIS Volume 1, page 4-23). "Exhaust emissions from laser activation have the potential to harm human health." "Laser beams can cause serious health problems if they contact the skin or eyes" (Volume 1, page 4-34). The PEIS should include all proposed laser test sites including the BOA, and, what experiments will take place at each site, and the total amount of acreage needed as a safety zone. For example, will the Airborne Laser 'test fire' at targets or interceptors launched from Vandenberg AFB, Kwajalein, Kodiak Island, Fort Greeley, or Poker Flats Rocket Range, Alaska?

The Alaska Aerospace Development Corporation (a.k.a. Missile Defense Agency) has requested jurisdiction over an additional 14,000 acres of Narrow Cape '*public*' land on Kodiak Island, Alaska, over and above the 3,800 acres it already has jurisdiction over. The PEIS should include what type of BMDS testing/activity is being proposed for the Kodiak Launch Complex that would require almost 18,000 acres of public land. Since the request was made *after* the release of the July 2003 Ground-Based Midcourse Defense (GMD)-Extended Test Range FEIS, the reason for the request should have been included in the BMDS Draft PEIS.

The Draft PEIS did not give enough detail on the variations of BMDS 'Directed Energy' weapon systems in Appendix F--'Advanced Systems' (e.g. high-powered microwaves), or proposed ground-based test locations. All proposed plans should be included in the PEIS for directed energy weapons. A high-power 'electromagnetic' phased array radar network is located on Kodiak Island, Alaska, but the MDA has refused to acknowledge its existence or purpose in all previous Kodiak Launch Complex Environmental Assessments since 1999 (when the microwave system started operating). The microwave's 1.9 Mega Watts (MW) of power has the potential to be used as a BMDS weapon by turning on its high power and directing it at a target or missile, thereby disabling the target's electronics and/or 'heating' up the target and causing it to explode in flight. The U.S. Air Force has received funding for several years for its 'Directed Energy' or 'Electromagnetic Warfare' program (which includes high-powered microwave systems). It is time for the MDA to 'declassify' the program and acknowledge the Kodiak microwave and explain how it will be used in BMDS testing and the human health hazards to Kodiak Island residents from the electromagnetic radiation (EMR) when the microwave is operating.

Draft PEIS Volume 2, pages D-25, D-26 (Exhibit D-6) states Ground-Based 'Interceptors' will be launched from the Kodiak Launch Complex (KLC), Alaska. In the Fall of 2003, a press release by the MDA stated only target missiles, not interceptors would be launched from the KLC. No previously released EAs or EISs have included plans for launching interceptors from Kodiak Island.

Kodiak Launch Complex and Kodiak Island issues that should have been discussed in detail in the BMDS Draft

DC_E0319

PEIS are:

(1) Island-wide areas that will be evacuated for BMDS activity
(2) Health and Safety procedures for exposure to launch debris- especially for potentially affected populated native villages such as Old Harbor and Akhiok
(3) Doing a site-specific operating document (referred to in Volume 2, page H-13)
(4) The potential electromagnetic explosive devices, ionizing and non-ionizing radiation hazards
(5) Hazards and trajectories of interceptors
(6) Special Use Airspace and Domestic Warning Areas

'Generally, sites where activities for the proposed BMDS activities may occur are located far from towns and population centers and are surrounded by open space' (PEIS Volume 2, page H-14).
This does not apply to the Kodiak Launch Complex. The test site is located only a few miles from a populated and State of Alaska recreational area. Cabins, homes, bed and breakfast accommodations are located near the Pasagshak River, which is highly frequented by fishermen and tourist during summer months, and hunters and recreational users during the winter months. Cabins and homes are in year-around use in the winter unless the roads are impassable due to snow coverage. However, this is not expected to be a problem since the road to the launch site has to be accessible to workers (especially in preparation for an upcoming launch). The PEIS needs to discuss proposed BMDS activity on Kodiak Island in detail.

BMDS Draft PEIS Volume 2, Page D-27—Deployment; MDA proposed plans for 2004-2005 include as many as 16 interceptors (GBI) at Fort Greeley, Alaska and 4 interceptors at Vandenberg AFB, California; However, no mention is made regarding the number of interceptors at the KLC. *Why not?* Are missile silos being proposed for Kodiak Island? If so, how many? If not, state the launch method. The safety hazards of launching interceptors from the KLC should have been discussed in the Draft PEIS, considering the high winds which occur on Kodiak Island throughout the year-- peak gusts up to 35 miles per hour in June and 83 miles per hour in December (PEIS Volume 2, Page H-18, Section H.2.1—Air Quality). As Kodiak residents have previously pointed out to the MDA in other EA comments (which the MDA has ignored), launching missile targets, and now possibly *interceptors* in a southwest trajectory down the East side of Kodiak Island would be extremely risky and potentially hazardous should a launch accident occur, because of populated native villages (e.g. Old Harbor and Akhiok) which are within the 'explosive safety hazard zone'.

Include in the PEIS the projected *cumulative impacts* from 'radiation fallout' for all space-based weapon systems (lasers, interceptors, warheads, e.g.).

Page 4-112, Section 4.1.4--Cumulative Impacts, does not give any useful or detailed information regarding the 515 projected BMDS launches during 2004-2014. The PEIS needs to include a breakdown of the 515 proposed launches and where each launch will take place (ground-based, sea-based, and space-based test locations). Where did the MDA come up with the 'magic' number of 515? A total of only 10 launches per year have been proposed from the KLC in previous EA documents (Air Force, Army). The MDA needs to validate and justify the need for 515 launches, considering the fact that 'Emissions from activities for the proposed BMDS include carbon monoxide, sulfur oxides, nitrogen oxides, volatile organic compounds, hazardous air pollutants, and particulate matter'. 'Most sites where activities for the proposed BMDS may occur would be classified as a major emissions source' (BMDS Draft PEIS Volume 2, pages H-18- H-19—Existing Emission Sources)

The Arctic Council comprising government representatives from Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden and the United States, recently completed a report (October 21, 2004, Cambridge University Press), 'Impacts of a Warming Arctic: Arctic Climate Impact Assessment' (ACIA), which stated the Arctic is warming at an alarming rate. Scientists have not determined how much of the warming is due to human influence and how much is due to natural climate cycles, but whatever the cause, it is currently affecting indigenous Arctic people (hunters falling through the melting ice, declining reindeer herds and difficulty traveling in road less regions with no snow for sleds). U.S. Senators John McCain and Joe Lieberman said: "dire consequences of global warming in the Arctic underscores the need for their proposal to require U.S. cuts in emissions of carbon dioxide and other heat-trapping greenhouse gases (Associated Press, November 9, 2004).

The MDA's own admission in the Draft PEIS confirms the fact that: "Launches can contribute to cumulative impacts including ozone completion, global warming, and orbital debris, which could affect global warming and depletion of the stratospheric ozone layer (Volume 2, page I-2—Cumulative Impacts).

DC_E0319

The MDA must discontinue all future BMDS test plans which will contribute to further global warming or contamination in the affected Biomes listed in the PEIS; especially the Arctic Tundra Biome and the Sub-Arctic Taiga Biome-which includes areas of the Aleutian Chain where various radars or sensors are activated or will be activated as part of the proposed BMDS (e.g. Adak Island where the Sea-Based X-Band Radar will be home-ported, Shemya Island where the COBRA DANE is located, and the BOA in the Gulf of Alaska).

The 1990 Clean Air Act Amendments identified 188 chemical pollutants which cause or contribute to cancer, birth defects, genetic damage, and other adverse health effects. "The PEIS has not identified any environmental health and safety risks that may disproportionately affect children, in compliance with Executive Order (EO) 13045 as amended by EO 13229" (PEIS page 4-134, Section 4.7).
Executive Order 13045 of April 1997, states that each Federal agency, including the Department of Defense (as defined in 5 U.S.C.102)

(a) shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children, and
(b) shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

Executive Order 13229 (October 9, 2001) does not change the requirements of EO 13045 (April 21, 1997), it only amends section 3-306 of that order "for a period of 4 years from the first meeting" and inserting in lieu thereof "for 6 years from the date of this order". The PEIS cannot identify environmental health and safety risks if the Department of Defense (MDA) has not requested any studies on the issue.

The PEIS should include any environmental health hazard studies the Department of Defense(DOD) has done since 1997 on children living in communities near rocket/missile launch sites and/or U.S. military training bases world-wide. An excerpt from an October 1, 2004 DOD news release titled: 'DOD, California Perchlorate Sampling Prioritization Protocol Reached', stated: "Currently, no drinking water standard for perchlorate has been adopted". According to the news article, the DOD apparently is finally agreeing to involve itself with environmental studies, along with the state of California, to research the findings of large quantities of perchlorates in the state's drinking water. Since perchlorate is a rocket and missile propellant, and there have been no previous drinking water standards for the chemical, the PEIS cannot state without conclusive studies that there has been no health and safety risks to children (or the general public) who live near test launch sites.

Executive Order 13045, Section 1. Policy 1-101 states: "A growing body of scientific knowledge demonstrates that children may suffer disproportionately from environmental health risks and safety risks. These risks arise because: children's neurological, immunological, digestive, and other bodily systems are still developing; children eat more food, drink more fluids, and breathe more air in proportion to their body weight than adults". Section 2-203, "Environmental health risks and safety risks means risks to health or safety that are attributable to products or substances that the child is likely to come into contact with or ingest (such as the air we breathe, the food we eat, the water we drink or use for recreation, the soil we live on, and the products we use or are exposed to)". Once again, refer to Draft PEIS Volume 2, pages H-18, H-19—Existing Emission Sources; "Most sites where activities for the proposed BMDS may occur would be classified as a major emissions source". It is the *major emission sources* related to MDA activities, which has the people living near launch test sites concerned. The PEIS should include *ALL* test sites locations that will be affected by future BMDS activity.

Another area of concern that is mentioned in the Draft PEIS, is the MDA's current testing of Israel's 'Arrow Weapon System' in the United States. The October 24, 2003 'Arrow System Improvement Program (ASIP) Environmental Assessment' (EA), discusses the MDA testing of the system over a 4 year period, with "targets being launched from either the Mobile Launch Platform in the Point Mugu Sea Range or Vandenberg AFB". According to the Arrow System EA, the Arrow interceptor would intercept a "liquid-fueled target system (LFTS) that uses a main liquid fuel, an oxidizer, and an initiator fuel for vehicle motor ignition and propulsion". The EA further states: "the Arrow interceptor missile is a two-stage vehicle launched from a six-pack mobile launcher. The missile contains approximately 1,670 kilograms (3,600 pounds) of solid rocket propellant in the booster. The interceptor with the propellant has a hazard classification of 1.3 and consists of hydroxyl terminated polybutadiene (HTPB), ammonium perchlorate, and aluminum powder. The interceptor also contains an optical (infrared) seeker and a radar sensor. The payload includes a focused blast-fragmentation warhead, with a hazard classification of 1.1D. Combined, the Arrow interceptor missile with its payload has a hazard classification of 1.1."

Considering the Arrow interceptor missile has a Hazard class of 1.3 ('mass fire') and the payload's warhead a Hazard class of 1.1 ('mass explosion'), the PEIS should include information on all potential ground-based hazards (and locations) and space-based hazards from the Arrow 'interceptor' and exploding 'warhead' that will release

DC_E0319

chemicals and add to further air and land contamination if there is a launch accident (or even if there is not an accident). Also, list the name of the warhead in the PEIS. It should have been listed in the Draft.

In fiscal year 2004, the ASIP "Caravan 2 would consist of two flight tests of the enhanced Arrow Weapon System at a U.S. test range (to be determined) against a threat-representative target at approximately full range" (BMDS Draft PEIS, Volume 2, page D-46).

The October 24, 2003 'Arrow Weapon System Improvement Program EA'—Alternatives to the Proposed Action—Alternatives Not Carried Forward, states: "A number of candidate test ranges were examined, in addition to the Point Mugu Sea Range. All of the candidate test ranges were analyzed for various operational and technical considerations including safety, range availability, instrumentation, operational cost, and logistical support. At the conclusion of the evaluation, only the Point Mugu Sea Range met the ASIP test program requirements".
This is contradictory with the statement in the Draft PEIS (Volume 2, page D-46), which states a U.S. test range "'would be determined" for the Caravan 2 flight tests.

Since the release of the ASIP EA in 2003, the BMDS PEIS should include all updated plans to launch the Arrow interceptor missile from other test launch sites/locations (e.g. Reagan Test Site, Kwajalein Atoll, Aleutian Chain, Gulf of Alaska, Poker Flats Rocket Range, Fort Greeley, or the Kodiak Launch Complex).

The fact that Israel does not have land available for 'interceptor' missile testing, does not justify the MDA's decision to bring and test another country's 'experimental' war weapons into the U.S, which will contribute to the pollution of U.S. oceans, drinking waters, air and land. Nor should the MDA be helping Israel by testing weapons that will then be shipped back to Israel to be used against its enemies in its 'religious' war, in order to further the 'Israeli Terminal Missile Defense' program. The United States should be doing what it can to negotiate peace rather than promoting war via another country.

The wording is not much different in the excuse the MDA gives for testing the Arrow interceptor in U.S. territory-"Commitments to Israel would not be fulfilled, and the United States would not realize any benefits to its own Terminal Missile Defense test program from participation in the ASIP" (Arrow System Improvement Program EA, October 24, 2004). Regarding the BMDS Draft PEIS and No Action Alternative, the MDA comments: "This alternative would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress to defend the U.S. against ballistic missile attack". Perhaps the PEIS could explain exactly what the President and Congress have proposed for the BMDS, because the MDA evidently does not know 'the specifics of the final architecture or operational requirements' otherwise, the information would have been included in the Draft PEIS, so the public would have an Alternative 3 option to comment on that did not include 'exploding' missiles in space or firing space-based lasers at ground targets, which eventually will lead to the U.S. Department of Defense's control of space by the year 2020 (U.S. Air Force, Vision 2020).

The PEIS needs to explain how the method of launching and exploding missile targets and interceptors in space is going to protect the U.S. borders and coastlines and deter 'terrorists' threats or attacks. Unless the MDA plans on tracking terrorists by infrared satellites, firing an Israeli 'Arrow' interceptor or space-based laser weapon at them before they cross over U.S. borders, the BMDS will prove to be useless in protecting the United States.

Since no Alternative 3 is listed, the BMDS Draft PEIS is also 'useless' and a waste of the public's time to comment, because the MDA really does not care to hear what the public has to say, and most likely, Volume 1 of the BMDS PEIS has already been printed and the MDA is waiting to receive and include public comments before releasing it and publicly announcing to the news media that the BMDS is 'deployed'.

Please send an e-mail acknowledgement that my comments have been received. Thank you.

Carolyn Heitman

DC_E0320

Johnson, Kathryn

From: Lauren Ayers
Sent: Monday, November 15, 2004 3:14 AM
To: mda.bmds.peis
Subject: Comments on the BMDS PEIS

To Whom It May Concern,

I've been alerted to the problems of BMDS and am submitting these comments on the PEIS.

My major concerns have no place in the narrow confines of the comment process but I add them at the end anyway because the unintended consequences of many seemingly benign endeavors have come back to haunt humanity.

To directly address the impacts of BMDS, I have these comments:

1. It is too expensive for what we get. The opportunity cost of that money going to BMDS could bankrupt us the way the USSR exhausted itself with its military budget. We would be better off with a more educated population who have decent jobs, and a cleaner environment, which we won't be able to afford.

2. The hydrogen chloride injected into the atmosphere with each launch has incredible potential to neutralize ozone, enlarging the famous hole which now requires Australian school children to be outside only with hats and long-sleeved shirts.

For the larger picture:

As a teenager, I was proud that my father worked for the Arms Control & Disarmament Agency. Besides the huge tax savings that resulted from the test ban treaties, we have no idea of what sort of nuclear catastrophe we avoided.

Much later, when President Reagan brought up his Star Wars notion, the feasibility reports made it clear what a ridiculous idea this was, like trying to stop a bullet with a bullet. Nevertheless, by preying on Americans' fears, Star Wars was moving ahead. Luckily, the collapse of the Soviet Union ended the foolishness.

By building Star Wars, we set a terrible example to other nations that we intend to be invulnerable, and therefore we become a threat to all other nations. They have no reason to trust us not to initiate war.

We now live in a world of terrorist threat. We need to learn that resentment of imperious America fuels more violence than we can ever head off, and that threats to our security will be as low tech as having religious fundamentalists give up their lives to pilot planes into office buildings. Fairness, respect, and cooperation are key in defusing

True, there are other nuclear nations that could launch against us. However, it would be far wiser to give every North Korean, Pakistani and Indian a share of what it would cost to build Star Wars so they can buy land, build houses, start businesses, and educate their children. Peace comes from contented people in prosperous nations.

Americans don't pay much attention to complex technological and scientific issues. But when they find out the monetary and social costs of following the wrong experts' advice, they get very angry.

Citizens rose up to stop above ground atomic bomb testing and supported the test ban treaty. We insisted on the Clean Air and Clean Water Acts. We buy more organic food every year because that is safer to eat and better for the environment.

Why not do the right thing now, instead of trying to clean up the mess later? An ounce of prevention is worth a pound of cure.

DC_E0320

Lauren Ayers

DC_E0326

Johnson, Kathryn

From: peter cohen
Sent: Monday, November 15, 2004 1:42 PM
To: mda.bmds.peis
Subject: BMDS PEIS

Peter G. Cohen

November 15 2004

BMDS PEIS

PURPOSE: As all of the nations capable of deploying intercontinental ballistic missiles are either allies or friendly, the need for this system has not been established.
The real danger of hostile nuclear weapons being delivered to the United States or allies by rogue nations is not addressed by this program. The real danger being the sale or theft of nuclear materials by hostile nations or groups from existing stocks. It is well known that these stocks are not properly guarded or disposed of and that insufficient moneys are being deployed by the U.S. to accomplish this defensive measure promptly and completely.
Thus, the real danger is not addressed by the proposed action, while its extreme technical difficulties and great cost further delay the prompt securing of radioactive materials worldwide.
Furthermore, this Maginot Line in the sky will stimulate other nations to develop the means to penetrate this defense before it is even completed. For example, our own new high speed drone could deliver a weapon at such speed as to make interception impossible.

PROPOSED ACTION: The definition of the proposed action includes preparations and deployment, but does not mention use of the proposed integrated system. If it is deployed and used against missiles carrying nuclear weapons, the detonation of these weapons in flight will cause radioactive materials to be widely dispersed in the atmosphere around the world. Recent studies by the CDC /NCI conclude that thousands of Americans have contracted cancers and died from U.S. testing of nuclear weapons 1950-61. Recent studies in the Chernobyl area have shown that genetic defects caused by radiation are passed down from generation to generation. In other words, there is a very real danger that the use of this system would further degrade the human gene pool. The effects upon the continuation of ocean life are unknown.
The testing of the system at Vandenberg AFB has inevitably had the effect of polluting the surrounding area with perchlorates. We do not know the extent of birth defects and growth retardation caused by rocket fuel in this area because no studies among this population have been done. The testing and deployment of the BMDS should be halted until the effects on the human population are known.

METHODOLOGY: Most scientists agree that the process of ³incrementally develop and deploy² being used in this system is the most expensive and least feasible method of developing a working system. As you are well aware, many of the necessary systems have not been tested and no tests have come close to battlefield conditions. It is against Pentagon rules for procurement to go forward on an unproved system.

CONCLUSION: As the environmental impacts of testing and operating this system are dangerous to an unknown degree, and as the benefits to be derived are highly questionable and alternative protections in universal nuclear disarmament are both pledged by the U.S. and possible, no further funds should be

DC_E0326

appropriated and testing and deployment should cease immediately.

DC_E0332

Johnson, Kathryn

From: TOHaig
Sent: Monday, November 15, 2004 5:17 PM
To: mda.bmds.peis
Subject: Star Wars PIES

1. The three alternatives being considered are insufficient and deceptive. "No Action" is an endorsement of the current ABM program which is badly flawed and which should be terminated. The PIES as it is being conducted does not meet congressional requirements and must be started over with real alternatives.

2. Placing weapons in space is inherently destabilizing -- upsetting international relationships, forcing response in kind, creating dangerous confrontations, accidents, and errors. If weapons are placed in space they will be used in space resulting in disasterous pollution by debris, and most probably, by radiation.

3. We already know from previous tests that nuclear weapon detonations in or near space cause long-term radiation pollution and serious disturbance of the Van Allen belts, damage and destruction of satellites over vast expanses of space, as well as interruption of power grids and communication nets on the ground. Once weaponization of space starts the use of nuclear weapons will be unavoidable, and of terrible consequence to the US.

4. There is no such thing as a purely "defensive" weapon. Once a weapon is created and deployed it can, and will, be used offensively. The Star Wars objective, "To project the power of the US globally so as to dominate the world" (a quote from the AFMSC presentation) is that of apocalyptic visionaries and has no place in rational considerations of US best interests. The Star Wars concept does not advance or protect the interests of the US, it destroys and defeats our true and traditional interests. It is not a defensive system, it is offensive in every meaning of the word.

5.. I have spent a lifetime working with missles and satelites. I know just how reliable they and the people who operate them are. I find it easy to foresee the disasters that will occur with a new collection of weapons on earth or in orbit designed for instant activation, instantanious response. We shot down an innocent commercial airplane over the Mediterranean using "conventional" weapons. Just think of the accidents we will cause with Star Wars !!

6. There is no actual threat to the US that can possibly justify Star Wars. There is no conceivable threat that Star Wars weapons could address that could not be met more effectively by other means already available. There is no reason for Star Wars -- just the irrational ambition of some to dominate the world. And the cost!!! We have already poured 100 billion dollars down the ABM rathole -- and into the aerospace industry for a useless, untested "system" that won't work, deployed against no threat. We must not continue this enormous waste while our infrastructure, our schools, our health programs suffer for lack of funds. We are a nation of idiots!

Thomas O. Haig
Col. USAF (retired)

DC_E0343

Johnson, Kathryn

From: anne Kelly
Sent: Tuesday, November 16, 2004 12:45 AM
To: mda.bmds.peis
Subject: final eis comment

anne Kelly

November 16, 2004

Missile Defense Agency
MDA BMDS PEIS, c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Missile Defense Agency:

I am writing to support a real "No Action" alternative to the deployment of a missile defense system. This means no further testing, development, or deployment. Deployment of such a system threatens a new nuclear arms race, puts the global environment at risk, and does not improve the security of the United States.

Sincerely,

anne kelly

DC_E0347

WOMEMWITH HILL WOMEN'S PEACE CAMP(AIGN)
C/o 8 Somerville Terrace, East Busk Lane, Otley, West Yorkshire, UK

Submission for the attention of

MISSILE DEFENSE AGENCY
DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT
Mda.peis@cfconsulting.com

[Further details and supporting evidence for all statements made in this submission are available on application to Anne Lee, only if required for the purposes of the public consultation relating to US Missile Defense Agency's Programmatic Environmental Impact Statement]

Introduction

WoMenwith Hill Women's Peace Camp(aign) is a non-violent direct action campaign focused in opposition to Menwith Hill Station and in addition calling for the closure of US Bases in Britain and around the world. We are also affiliated to the Global Network Against Weapons and Nuclear Power in Space, the Yorkshire Campaign for Nuclear Disarmament and the Menwith Hill Forum (a locally-based group set up to examine issues of public concern resulting from the presence of the US Bases at Menwith Hill and Fylingdales).

The WoMenwith Hill Women's Peace Campaign is aware of, and supports all objections to, the degradation of the earth and space environments, which are and would result from implementation of the United States' Missile Defence programme. It is with this overall detrimental impact in mind that we submit our representation, specific to the programme's environmental impact at the ground stations and more specifically at Royal Air Force Menwith Hill and Royal Air Force Fylingdales Stations in the British Isles.

Crucial to the US Missile Defence programme is the stationing of 'forward surveillance' facilities located outside the continental USA at US Bases on land it is permitted to use by host nations. The political structure of such nations may be very different from the Federal Government (e.g. Britain is a Monarchy: q.v. 'Crown Defence Land'). The legislation regulating environmental controls in other countries may be very different, possibly more stringent, than that which obtains within the USA. It is incumbent on the Missile Defense Agency to apprise itself of, and publish an undertaking to comply with, mandatory statutory requirements wherever on the Earth it proposes to site Missile Defence facilities.

We submit that the following observations, although relating mainly to our personal experiences of the position at the US Bases at RAF Menwith Hill and RAF Fylingdales, both in North Yorkshire, England, have wider relevance. The Missile Defense Agency's Programmatic Environmental Impact Statement must acknowledge and include Environmental Impact Assessments for each and every US Missile Defence Base proposed to be sited on land in nations with British or British Commonwealth status, and also in other independent sovereign nations (e.g. Denmark's sovereignty over Thule).

The global ground stations operate as:

- Downlink and relay stations for a global surveillance network, principally deploying signals' intelligence and photo-reconnaissance satellites to assess *inter alia* preparations to launch intercontinental ballistic missiles (ICBMs).

- Downlink and relay stations for a satellite infrared tracking system to provide early warning of and tracking, after launch, of ICBMs targeted on the continental USA.

- Early Warning Radar Stations positioned around the Arctic Circle to identify a launch of ICBMs targeted on the continental USA and continue to track them in flight.

- Proposed launch sites for interceptor missiles to attack ICBMs.

Global Surveillance Network

The long-established US satellite-surveillance downlink and relay Bases, such as Menwith Hill and Pine Gap, positioned around the world for the purpose of intelligence gathering, are necessary components of the US Missile Defense System, as they would be used to monitor in advance, the preparations for the launch of a rocket. These facilities comprise part of the US Missile Defence system package and exclusion from the US Missile Defence Agency's Programmatic Environmental Impact Statement deliberations cannot be justified.

Britain and the British Commonwealth conveniently provide the USA with land for its surveillance stations around the world. Because of the 'special relationship' binding Britain, the USA considers that ground stations located on British or British Commonwealth soil to be particularly secure. Thus the USA has surveillance facilities located in the British Isles, Canada, Australia, New Zealand, Ascension Island and Diego Garcia or co-located with British surveillance facilities (e.g. Cyprus).

The British Government has been compliant in acceding to the wishes and interests of the USA, even going so far as to evict the population of the Chagos Islands to permit the construction of the US Base on the island of Diego Garcia.

US Missile Defence at Bases in Britain: Recent History

Specific to the US Bases in England, the British Government has already granted permission for the USA to upgrade the Early Warning Radar at Fylingdales and agreed that, if necessary it may be used for US Missile Defense. Further formal requests for the Missile Defense use of Menwith Hill, as a satellite downlink and relay for infrared tracking systems; construction of an X-Band Radar, and the stationing of the interceptor missiles in Britain, are anticipated.

RAF Fylingdales

The formal request for the use of RAF Fylingdales for US Missile Defence purposes was announced by the Rt Hon Geoff Hoon, Secretary of State for Defence, in the House of Commons on 15 December 2002. His decision to grant permission was deferred to allow a public consultation exercise to be carried out. This was curtailed by the imposition of a deadline of 15 January 2003 (the Christmas Recess of Parliament intervened) for representations to be submitted to the House of Commons Defence Committee and 31 January 2003 for the public announcement of his decision.

In January 2003, we contributed submissions to the deliberations of the House of Commons Defence Committee. The public consultation period was a totally inadequate farce of democratic procedure. The Committee was extremely worried that the Secretary of State for Defence had rushed through the procedure with unseemly haste and even publicly announced his decision prior to issuance of the Committee's conclusions.

On 29 January 2003, the House of Commons Defence Committee published its conclusions. (*MISSILE DEFENCE Report of Session 2002 – 03, HC 290 – 1*). It contained a strongly worded criticism accusing the Secretary of State for Defence of stifling the debate:

'Despite the Secretary of State's unequivocal statement that he wanted the decision to be informed by public and parliamentary discussion, he has acted in a way that has effectively curtailed such discussions…

'…we deplore the manner in which the public debate on the issue of the upgrade has been handled by the Ministry of Defence. It has shown no respect for either the views of those affected locally by the decision or for the arguments of those opposed to the upgrade in principle.'

The Committee demanded further information about the nature of the Early Warning Radar upgrade, its operations and the impact on the environment. They stated that:

- The upgrade will not simply be replacement of old computer systems. It will be a change of use.
- In addition to the radar identification and tracking capabilities the upgrade will incorporate *'support* [for] *the capability of the interceptor missiles'*.
- The existing agreements, which allow the USA's operations at Fylingdales and Menwith Hill, do not permit the use of these Bases for US Missile Defence.
- The possible hazard of the radio frequency radiation emissions from the radar had not been properly investigated and there was considerable public concern.

Nevertheless the House of Commons Defence Committee did conclude that it was permissible to allow this limited upgrade Fylingdales Early Warning Radar and its use '*in missile defence mode*' for US Missile Defense purposes.

Their conclusion is wrong.

The installation and operation of components of the USA's Missile Defense System on Britain's Crown Defence Land is unlawful and would require a new Act of Parliament.

The Defence Committee's demand for further information was acknowledged on 16 June 2003 by the UK Ministry of Defence's publication of a Report: *'Upgrade to RAF Fylingdales Early Warning Radar – Environment and Land Use Report'*. This may be found at http://www.mod.uk/publications/raf_fylingdales_upgrade/

The MoD's Report did not address the Committee's concerns

- About the implications of the change of use.
- Whether the existing agreements legally permit the development.
- It dealt inadequately with the concerns about the effects of the radar emissions.

The MoD's Report is also inaccurate in several identifiable areas.

The MoD's Report is not an impartial assessment conducted by an independent inspector. Its purpose is a propaganda exercise, to reassure Parliament, the public and especially the North York Moors National Park Authority, the local Council responsible for the upkeep of the National Park, which includes the Fylingdales area. The MoD's Report asserts that no Planning Application for the radar upgrade would be necessary, because the environmental impact would be *de minimus.*

A Planning Application, which would necessitate consultation with the Council's Planning Committee, would have allowed the public the opportunity to make comments and objections at a public Council Meeting reported by the media. Objectors to the development were thus denied the opportunity of a platform to state their arguments and make demands for an impartial Environmental Impact Assessment, Archaeological Survey and Public Inquiry.

A '*Response*', to the MoD's Report, submitted on behalf of WoMenwith Hill Women's Peace Camp(aign), was delivered to the North York Moors National Park Authority, in advance of its full Council Meeting on 29 September 2003. At this meeting the decision relating to the requirement for a Planning Application for the Fylingdales' upgrade was to be determined.

Six days in advance of the supposed democratic, decision-making meeting, the media published a statement from the Council that no Planning Application was required. The Chief Planning Officer's decision, was based on the assurance in the MoD's Report that, because there would be no alteration to the physical appearance of the site and no increase in Radio Frequency power radiating from the pyramid, there could be no grounds requiring submission of a Planning Application.

'Change of use' of premises (e.g. a shop to offices) normally requires a Planning Application and would have justified such for the Fylingdales upgrade.

The WoMenwith '*Response*' was circulated to the UK Ministry of Defence Estates' Organisation in September 2003. To date no reply has been received. We believe this may be because the Ministry of Defence is avoiding addressing the assertion that their Fylingdales' Upgrade Report contains inaccuracies.

The Defence Secretary's decision, in December 2002, to defer consideration of the associated X-Band Radar (which would be a major construction and would require a Planning Application and probably Public Inquiry) may be a reaction to the strength of public opinion. In 2002, the media reported widespread public concern about the abrogation of the Anti-Ballistic Missile Treaty; the implications of Britain's involvement with 'Star Wars' and fears that the upgrade of Fylingdales represented the 'thin end of the wedge'. Many people suspect that by deferring consideration of X-band Radar plans to a future date, the Secretary of State for Defence was deploying a tactic to try to defuse objections by introducing the US Missile Defence programme's components in piecemeal instalments.

Although the Fylingdales' radar upgrade was stated not to justify a Planning Application, this would not be true of either X-Band Radar installations or missile interceptor launch sites. Proposals to construct such would generate mass opposition. There would be objections from the peace movement and environmentalists internationally in addition to local concern for the consequential environmental degradation to the locality. US Missile Defence developments would be challenged through Parliament and the normal channels for presentation of arguments at Public Inquiries.

Some of the opposition to further developments would involve an escalation of non-violent direct action, similar to that at Greenham Common in the 1980's.

On 13 April 2004, BBC TV carried the news that work had started on the Fylingdales 'revamp'.

On 17 October 2004, the media carried the 'leak' that a secret, top-level agreement had been reached to permit siting of missile interceptors in Britain.

On 14 November, *The Observer* published a letter from the Secretary of State for Defence denying that missile interceptors would be placed at Fylingdales or that any secret discussions had taken place.

Menwith Hill

It is not generally acknowledged that the whole of Menwith Hill's Operations plays a role in US Missile Defense.

The long-established signals' intelligence systems have the capability to detect the advance preparations prior to a missile launch, and convey that information via the US National Security Agency's Defense Special Missile and Aeronautics Center at Fort Meade.

Two radomes and operations buildings for a space-based infrared tracking system have already been installed and the Station's organisation restructured, in advance of any permission for its use for US Missile Defense. The satellite infrared capability can track ICBMs at and after launch.

During the past two years or more there has been a steady stream of Planning Applications to the Harrogate Borough Council for infrastructure expansion at Menwith Hill. Indications are that the Base operations are due to expand c. 50% (e.g. a recent Planning Application is for 50% increase in the electricity generated for use by the satellite downlink and computer operations).

As at Fylingdales, there are suspicions that dribbling through the Planning Applications may well be a deliberate policy to defuse objections. Gradual introduction of these plans means that each is considered individually and not in the overall context of the as the total package. Public opposition, therefore, has been virtually non-existent

Because of regulations relating to developments on Crown Land (q.v. 'Crown Defence Land: Ownership, Occupation and Use') prior to the introduction of new legislation in May, the Harrogate Borough Council had no statutory powers of enforcement should it have objected to any of these proposals for expansion at Menwith Hill. In practice the law has never been tested, because the Council almost unanimously supports the presence of the US Base. It is one of the biggest employers in the district and is said to benefit the local economy by $62M annually. A statutory Public Inquiry, which would provide a well-publicised platform for objections to be heard, can happen only by the Council's application. It may thus appear to be unrealistic in the prevailing circumstances to expect that the Harrogate Borough Council would ever request it.

There have however been two recent changes in legislation governing developments considered to have significant environmental impact. These are the provisions of the Aarhus Convention, allowing the public to have greater participation in decisions impacting on the environment and the European Parliament's removal of the Crown Land exemption from the Environmental Impact Assessment, which must accompany any substantial development proposals (q.v. 'Crown Defence Land: Developments: Environmental Impact').

An argued case calling for Environmental Impact Assessment, Archaeological Survey and a Public Inquiry was submitted by WoMenwith Hill Women's Peace Camp(aign) to the Harrogate Borough Council's Planning Department, and the Ministry of Defence Estates' Organisation, in response to a recent Planning Application to enclose the whole of Menwith Hill, including the areas of pasture, inside a razor-wire topped security fence bristling with CCTV cameras.

The case was submitted in January 2004, prior to the changes in the relevant legislation in May.

On 26 February, under the 'delegated legislation' arrangements, a non-elected Civil Servant (a Planning Officer) approved the plans.

Neither these plans, nor any others in the past two years, have been put on the Agenda for deliberation by the elected members of the Council's Planning Committee Meeting.

Crown Defence Land: Ownership, Occupation and Use: the Law

Ownership of Crown Land

Defence Land is designated 'Crown Land'. The three categories of Crown Land are:

- 'Crown Estate' is land owned by the monarch, the revenue from which accrues to the State in exchange for an income, apportioned by Parliament, for the royal family (the Civil List).
- Duchy of Lancaster and Duchy of Cornwall Lands are in the private possession of the monarch and the heir to the throne.
- Land owned by the State and administered by Her Majesty's Government, such as the Ministry of Defence. During the term of his Office, the Secretary of State for Defence is deemed for legal purposes to be the owner of the Crown Defence Lands, held in his trust on behalf of the nation.

The size of the Crown Defence Estate in the UK is 240,000 hectares (593, 052 acres). This includes considerable areas in North Yorkshire, England, most of which was appropriated during World War 11 and is surplus to any current requirement for military purposes.

Menwith Hill Station and Fylingdales Station are both located on Crown Defence Land in North Yorkshire.

Acquisition and Use of Land by the Secretary of State for Defence: the Law

The appropriation and management of land for the purposes of the defence interests of the British Isles is regulated by the Defence Act 1842 and the Military Lands Acts 1892 to 1903 plus subsequent amendments (e.g. to incorporate the Royal Air Force).

Defence Act 1842

Title: '*Acquisition and Use of Land'*

'Citation: to consolidate and amend the Laws relating to the Services of the Ordnance Department, and the vesting and Purchase of Lands and Hereditaments for those Services, and for the Defence and Security of the Realm'.

The 1842 Act, therefore, states specifically the purpose for which land in Britain may be appropriated and its use for '*the defence and Security of the Realm*'.

The Defence Act 1842 is the legislation passed by Queen Victoria, which established 'Her Majesty's Surveyors of Ordnance'. The Ordnance Survey, instituted for military purposes, eventually became the UK statutory civilian authority for mapmaking. Unless Parliament were to pass new legislation re-establishing Her Majesty's Ordnance Survey Department, the 1842 Act cannot be repealed.

The 1842 Act empowers the Secretary of State for War (now Defence) to purchase land either by agreement with the landowner or by compulsory purchase. The Act permits surveyors to enter onto privately owned land in order to survey it for the possibility of acquiring it for military purposes.

The Military Lands Act 1892

'PART 1

Powers to purchase land. – (1) A Secretary of State may purchase land in the United Kingdom under this Act, for the military purposes of any portion of Her Majesty's military forces'.

The 1892 Act is an attempt to form a single body of legislation incorporating and/or repealing the previous different Acts passed throughout Queen Victoria's reign.

The 1892 Act defines the extent of, but also the limitations on, the Secretary of State's management of Crown Defence Lands: *'…for the military purposes of any portion of Her Majesty's military forces'.*

Occupation of Crown Defence Land by a Foreign Power: the Law

The occupation of Crown Defence Lands by the visiting forces of a foreign sovereign power is governed by the provisions of the North Atlantic Treaty Organisation's Status of Forces Agreement (NATO SOFA), which was signed in London on 19 June 1951, later ratified by the UK Parliament as the Visiting Forces Act, 1952.

Article 1X (s.3) of the Visiting Forces Act states:

'…the authorities of the receiving State shall assume sole responsibility for making suitable arrangements to make available to a force or civilian component the buildings and grounds which it requires…'

The 1951 NATO SOFA was agreed

'…appropriate to the relationship which exists between the United Kingdom and the United States for the purpose of our common defence' (Jeremy Hanley, Minister of State for the Armed Forces, in reply to the late Bob Cryer MP, 25 March 1994. *Hansard*)

The stipulation '*arrangements for common defence'* is stated by the NATO SOFA, the Visiting Forces Act and repeated in the updated International Headquarters and Defence Organisations Act 1964.

In 1999 the legislation was amended by Order in Council to take account of recent changes in legislation (e.g. the Town and Country Planning Act 1990). The amendment to the existing legislation is the Visiting Forces and International Headquarters (Application of Law) Order 1999 (Statutory Instrument 1736).

Significantly, in light of the USA's request for its unilateral use of lands allocated for NATO purposes, the 1999 Statutory Instrument omits to repeat '*arrangements for common defence'*. Nevertheless, as the originating Acts have not been repealed, the condition stating *'arrangements for common defence'* remains applicable.

The Law is specific, the Secretary of State is granted statutory powers to acquire and manage land for the purpose of the defence of the realm - and not for the purpose of the exclusive defence of a foreign power, whatever the relationship between Britain and that nation.

The Law does not empower the Secretary of State to grant the USA, or any other foreign power, military use of the Crown Defence Lands in his care, unless it is specifically used for the defence of the British Isles. Thus the Law would disallow the USA's use of UK Defence Lands for the USA's Missile Defence system, which is not designed to protect the British Isles from an attack by Intercontinental Ballistic Missiles. US Missile Defence is exclusively for the protection of the continental USA.

The Law allows foreign power member of NATO to conduct military activities on Crown Defence Land in support of NATO. For example, to comply with the Law, the interception of communications by the US National Security Agency at Menwith Hill Station must be for military purposes only - and on behalf of NATO. The collection of intelligence exclusively for US national interests or any other purpose (e.g. political, diplomatic or commercial, such as the collection and distribution by the ECHELON global network) is an illegal misuse of Crown Defence Land.

This begs the question of whether the NATO SOFA '*arrangement*' for the USA's occupation and use of Menwith Hill and Fylingdales is legitimate and whether the Secretary of State for Defence knowingly colludes with the conduct of illegal activities (q.v. 'Collusion: Environmental Impact'). The Law is clear - the entire function, not just part, of the operations at Menwith Hill Station and Fylingdales must be for British and NATO military activities conducted in defence of the UK.

The High Court of the Royal Courts of Justice has examined in what circumstances the US Bases' authorities are exempt from compliance with the law and the jurisdiction of the Courts (Menwith Hill US Base Commander, Colonel G Dickson Gribble v Helen John, 31 July 1997).

The Office of Secretary of State, whether of Defence or of any other UK Government Ministry, does not confer on its holder a statutory authority to negotiate disposal of national assets, such as Crown Defence Land, to a foreign power.

It would appear that the Secretary of State for Defence, the Rt Hon Geoff Hoon MP, has exceeded and abused the powers granted to his office.

We believe his action is in Law *ultra vires* and *mala fides* and therefore Treason.

Crown Defence Lands: Developments: Environmental Impact

Since the Fylingdales and Menwith Hill submissions, there has been a significant step towards implementation of the Aarhus Convention, which gives the public greater participation in the decision-making process related to developments having impact on the environment.

In January 2004, the European Commission considered taking legal action against the UK over failure to comply with European Union's legislation requiring that Environmental Impact Assessments be carried out prior to certain developments. The European Commission took the first step in the legal procedure, when it issued a final warning to the UK Government, stating that its legislation was inadequate to cover developments on land owned by the State (i.e. Crown Land).

Crown Land was excluded from statutory planning enforcement and exempt from the various UK regulations transposing the EU's Environmental Impact Assessment Directive (85/337/EEC as amended by 97/11/EC) into UK Law.

The UK Government maintained that administrative procedures already existed under the Town and Country Planning Act 1984 (Department of the Environment Circular 18/84) to ensure public consultation on Crown Land developments. However, the European Commission considered that legislative measures incorporating statutory powers were needed. The UK Government accepted this as necessary and the relevant legislation removing 'Crown Immunity', the Planning and Compulsory Purchase Act, received Royal Assent on 22 May 2004.

Possibly it is significant that the raft of measures for the expansion of Menwith Hill's infrastructure was submitted in the two years prior to 22 May 2004.

Proposed developments on Crown Land are subject now to the normal statutory planning controls. This will include a statutory requirement to conduct Public Inquiry to consider evidence of the implications of major development proposals and to conduct a full Environmental Impact Assessment and Archaeological Survey.

It remains to be seen whether the UK Ministry of Defence will successfully argue that future developments relate to UK 'national security' and whether they can be exempted from Environmental Impact Assessment under the new legislation. Presumably the Secretary of State for Defence would have to justify such a position and produce evidence for exemption – and prove that US Missile Defense functions for the 'national security' of the British Isles.

The proposal to construct X-Band Radar or locate missile interceptors at launch sites in the British Isles would be classified as a development requiring statutory Public Inquiry conducted by an impartial Planning Inspector. This would be conducted similar to a Court of Law to hear evidence from all interested parties including members of the public. The UK Ministry of Defence would not be permitted to issue its own Environment Report, such as that for the Fylingdales' Upgrade, arguing a one-sided case, to which the public made no contribution.

The conduct of non-statutory Public Inquiry, under the previous Circular 18/84 procedure, was carried out to examine the environmental impact consequent on the Ministry of Defence's plans for developments at the Otterburn Ranges on Crown Defence Land in the Northumberland National Park. The Public Inquiries ran for five years. In October 2001, in consequence of 9/11,the Planning Inspectors' recommendations were overridden. The UK Secretary of State for Defence ordered the developments to proceed. He then had the power to do this if it was perceived to be in the interests of the defence of the realm.

The recent changes in legislation under the Planning and Compulsory Purchase Act, 2004, remain to be tested.

US Bases on Crown Defence Land: Pollution of the Environment

The former Royal Air Force Base at Greenham Common serves as an example of the contamination resulting from its occupation by the US Airforce.

The information publicly available describing the restoration and regeneration of Greenham and Crookham Commons is published on the West Berkshire District Council website **http://www.westberks.gov.uk**. The website presents only a fraction of the overall pollution picture. In practice only the surface environment has had remedial treatment. The prohibitive

cost of investigating the underground contamination means that the total detrimental impact will never be assessed.

It is not possible to assess a figure for the costs incurred in the limited restoration of the surface of the land. The West Berkshire Council's figure of c. £1.5 million does not take account of the considerable unpaid work of volunteers.

The US Government has no statutory responsibility for, and makes no contribution towards, the cost of the clean up.

Fylingdales and Menwith Hill: Environmental Concerns

The following illustrative examples comprise only some of the environmental issues about which we have made representations to the relevant authorities in recent years. This list is by no means exhaustive.

- **The Environmental Impact of Fylingdales' Solid State Phased Array Radar: Radio Frequency Emissions**

There is widespread public concern about the detrimental environmental impact created by the Fylingdales' radar pyramid.

The foremost concern is the possible harmful biological effects of the non-ionising radio frequency emissions from the radar.

For example, the local village of Goathland is a major tourist attraction because it is featured in the Heartbeat TV 'soap opera' and its antique steam railway. Goathland is in direct line-of-sight from the Fylingdales radar pyramid and is therefore a recipient of RF emissions from the 'sidelobes' of the radar.

Although the UK Ministry of Defence assures the local population that the radar is entirely safe, it sets off car alarms and disables ignition systems as far away as Goathland. The Base authorities publish a health and safety guide for employees and visitors warning of these effects and the possible danger of creating a spark by induction if attempting to fill a petrol tank using a metal container.

There is no adequate official scientific study of the biological effects on plant, animal and the human body resulting from Fylingdales' radar emissions.

Professor Dave Webb, Chair of Yorkshire Campaign for Nuclear Disarmament, has published a paper, '*Is it Safe?*' which can be read at **http://cndyorks.gn.apc.org/fdales/**. Professor Webb maintains that the safety standards are inadequate and presents the evidence to substantiate his arguments. The reassuring conclusions published in the UK Ministry of Defence's '*Upgrade to RAF Fylingdales Early Warning Radar - Environment and Land Use Report*' are based on the inadequate safety guidelines . We endorse Prof. Webb's position and submit that his paper be considered by the US Missile Defense Agency as a contribution to public responses to the Programmatic Environmental Impact Statement.

- **The Environmental Impact on the Landscape: Visual Degradation**

Both Fylingdales and Menwith Hill occupy elevated positions in rural areas of high-quality landscape – in areas economically heavily dependent on tourism. The incongruous 'sci-fi' structures, Menwith Hill's 30 giant white 'golf balls' and Fylingdales huge truncated pyramid silhouetted against the sky, are visible for miles, especially from the surrounding hills.

Fylingdales is in the North York Moors National Park.

Menwith Hill overlooks Nidderdale. The boundary of the Nidderdale Area of Outstanding Natural Beauty (eventually to be incorporated into the Yorkshire Dales National Park) was tightly drawn around Menwith Hill's perimeter to exclude the Base on grounds that it is ugly.

The National Parks are areas of the British Isles, where a strictly enforced statutory conservation policy applies to preserve the rural amenity in perpetuity as a national heritage.

Only considerations of acute emergency national security would permit developments such as Menwith Hill and Fylingdales.

- **The Impact on Britain's Archaeological Heritage**

Both Fylingdales and Menwith Hill are sites of prehistoric importance known to date from the Neolithic period or earlier. Conservation of the archaeological heritage is a prime consideration in Britain and must be considered in the deliberations for the US Missile Defense Agency's Programmatic Environmental Impact Statement. The damage to these sites so far is incalculable. Herewith two examples:

Menwith Hill:
The Base is located on Forest Moor, an area of significance to archaeologists for its Neolithic settlement, testified by the wealth of flint microliths.

The site is adjacent to an Iron-Age Brigantian Fort. The Roman Road joining the fort at Ilkley (Olicana) to the city of York (Eboracum) borders the southern boundary of the Base.

The US occupants in c.1990 removed an ancient megalith known as 'Tibby Bilton', possibly the last standing remnant of a prehistoric group or circle of standing stones.

Fylingdales (or more properly, Snod Hill):
The presence of a tumulus, a group of (fallen) megaliths and petroglyphs is evidence that Snod Hill is a prehistoric funerary site.

Snod Hill is crossed by prehistoric trackways, ancient rights of way dating from the Bronze Age or earlier, for over two thousand years in use as a 'Salt Road' from the coastal settlements. The Salt Road is notorious in later history as a route for smugglers.

The Salt Road was closed peremptorily and permanently to permit the construction of the Early Warning Radar facilities.

- **The Environmental Impact on the Land: Flora and Fauna**

The location of Fylingdales Station gives rise to concern because of its proximity to Sites of Special Scientific Interest. Special conservation measures statutorily apply to such sites. In the case of Fylingdales it is because of endangered plant species and breeding sites for rare moorland birds. No construction work is permitted at Fylingdales during the birds' breeding season – April to August inclusive.

Herewith two recent examples out of the many complaints made to the Bases' authorities:

Fylingdales:

In January 2002 the unauthorised construction of a limestone internal perimeter patrol road, part of the security upgrade in advance of its US Missile Defence role, gave rise to fears that the effect would be to raise pH levels in the surrounding acid bogs. Construction work had to be halted to allow an Environmental Impact Assessment to be conducted. This was not an impartial assessment by an independent inspector, but a mitigation exercise carried out by the UK Ministry of Defence. In the event it was concluded that to remove the road and reconstruct it in a less alkaline material would cause greater damage than to permit it to remain.

Menwith Hill:
The discovery of a colony of rare feral orchids, in natural wetland on the north-west of the Base, led to an investigation by Professor Bateman, Keeper of Botany at the Natural History Museum, the country's top orchid expert. As a result of his research in 1999, the proposed high security fence was relocated to skirt the orchid site instead of cutting through it and the Menwith Hill authorities agreed to conserve the orchids' site as a reserve. Further complaints are ongoing because of their failure to implement Prof. Bateman's management recommendations.

- **The Impact on the Water Environment**

The UK Environment Agency is the statutory body responsible for monitoring and maintaining the quality of the water environment including the public water supply. It has no access or authority to investigate the Crown Defence Land inside the Bases, but it does monitor the emergent water outflows, including the sewage and can authorise remedial action.

Herewith two examples of recent complaints:

Fylingdales:
During the heavy flooding of 31 July 2002 the Fylingdales sewage works overflowed and raw sewage ran down the hillside and entered Eller Beck at Ellerbeck Bridge east of the Base. Eller beck flows through the village of Goathland. The Goathland Parish Council was informed and discussed the issue at its August Parish Council Meeting.

Menwith Hill:
The site causes concern because of its position on the gathering ground for the city of Leeds water supply. The surface water run-off from the Base enters Swinsty Reservoir via Spinksburn Beck.

The Menwith Hill Forum made enquiries recently about the history of environmental contamination resulting from the presence of Menwith Hill. The Environment Agency responded to the request and from its enquiries it emerged that a major spill of diesel fuel (the Station generates its own electricity from diesel generators) had occurred in the mid-90's, but that all the documentary evidence had been destroyed. The only surviving evidence is the memories of those personnel who were engaged on the remedial clean-up.

The fact that there was no public announcement at the time of this incident is one example that serves to indicate that it is not possible for statutory public authorities to assess the level of contamination created to the land and the water inside these Bases.

If such evidence cannot be presented to the Missile Defence Programme Environmental Impact Survey, how can it be taken into consideration?

Within the UK no official body with oversight responsibilities to monitor development abuses on the US Bases exists.

- **Unlawful Unauthorised Developments: the Environmental Impact**

There have been a number of instances where we have brought abuses of planning process to the attention of the relevant local government authorities and the UK Ministry of Defence. These include for example:

Fylingdales:
The security fence (and unauthorised internal perimeter police patrol road) on the southwest side of the Base unlawfully encroached outside the boundary of the Base onto land held by the Forestry Commission.

The Under Secretary of State for Defence was obliged to remedy the position by a transfer of land.

Menwith Hill:
The security fence in the Main Gate area unlawfully encroached onto the highways' verge outside the boundary. The fence had to be removed and reconstructed.

It is unacceptable that the UK authorities turn a blind eye towards unauthorised developments and it it incumbent on members of the public to have to complain.

- **Maintaining the Security: the Environmental Impact**

The Bases are acknowledged to be targets for 'terrorists'. The security of the Bases is totally ineffective and costs the USA and UK a considerable sum to maintain. Menwith Hill and Fylingdales bristle with razor-wire-topped high security fences, CCTV cameras, intruder alarm systems, and are constantly patrolled by armed police and guard dogs.

The UK Ministry of Defence Police Officers are ostensibly the defenders of the Bases. It is impossible for these Police Officers to secure the Bases, even were their numbers to be increased. Their main function is for propaganda purposes, to convey the impression that they are guarding UK facilities, which impression is reinforced in the Courts when they prosecute peace activists. The UK Government has admitted that at Menwith Hill they are actually paid for by USA, which not only reimburses the UK Government for personnel salaries and expenses, but also purchases and maintains their patrol vehicles and buildings.

The occupation of Menwith Hill by over 100 Greenpeace protesters in July 2001 revealed just how inadequate was the security. The response was to upgrade the security by installing more of the failed systems and increasing the police numbers.

The following public concerns have been reported in the local media:

- Councillors fear the consequences to the local community of an attack on Menwith Hill, particularly the consequences of a 'dirty bomb' on the environment and human populations.
- The Emergency Services would be unable to cope with a 'terrorist attack'.
- In November 2001 a hoax Anthrax scare at the Harrogate Postal Distribution Office was dealt with by the Emergency Services and disrupted postal deliveries. The hoax demonstrated how vulnerable the supplies and services to the Bases are to 'terrorist attack'.
- The consequences to the locality from a shower of missile debris produced by collision between ICBM and an interceptor missile.
- The cost to the local taxpayers of providing additional, civilian North Yorkshire police to patrol the Bases.

- The crime-wave in cities such as York attributed to the deployment of the civilian police to patrol the Bases.
- The recreational amenities, Yorkshire Dales' and North York Moors' tourist attractions, are patrolled by armed police.
- Protest actions will be stepped up with consequences for the local community, e.g. blockading traffic.
- Human rights and civil liberties are infringed by application of the Terrorist Act 2000, for a radius of ten miles surrounding Fylingdales and five miles around Menwith Hill, (e.g. s. 44 gives the police the right to stop and search any person without cause for suspicion) and by clandestine closed circuit television monitoring of the roads and surrounding countryside.

- **Logistics: the Environmental Impact**

The Bases are dependent on the support of the host nation. Their operations could not function without the logistics infrastructure, e.g. transport of supplies of water, food, electricity and disposal of sewage and garbage and a local workforce to service the Bases. All these impact on the environment external to the Bases. All are vulnerable to disruption (e.g. Some of the local workers are members of Trades Unions. The British Trades Union Congress of 2002 passed an anti-'Star Wars' resolution, condemning US Missile Defence).

Peace protesters have blockaded, and can be expected to continue to blockade, access roads to Menwith Hill, which obstruct movement of personnel and supplies into and out of the Base. Blockades have generated TV coverage allowing a platform for presentation of the arguments of the protesters.

In order to ensure that the essential services continue to be provided, it is politic for the Station authorities to maintain good relations with the host national government and the local community. Public relations' propaganda 'sells' a benign and positive image and conceals any information, which might reflect adversely on the Bases and their personnel.

Currently the UK national and local authorities collaborate in the practice of a deception to keep the public ignorant, complacent and co-operative (e.g. describing Menwith Hill as a 'Royal Air Force' Station is a blatant propaganda hypocrisy, intended to persuade people to believe that it is British and thus playing an essential role in the defence of the realm). Thus the UK State is complicit with the illegal operations at Menwith Hill.

- **The UK State's Collusion with US Bases: the Environmental Impact**

In a democracy the people elect their representatives and expect them to make decisions and appoint public servants to manage the State in the best interests of the electorate. If financial and other resources are expended on support for the US Bases, it follows that those resources are not available for investment in the environment (e.g. the North Yorkshire Highways' Authority must provide and maintain roads to and from the Bases, which are not necessarily of benefit to the wider community).

The collusion is not confined only to the legislative and executive arms of the State, described herein, but is also supported by the judiciary.

The Judiciary's support for the UK Government:
One example serves to illustrate that, not only is the UK Government aware of the illegalities perpetrated, it is prepared to condone them and its actions are supported by Her Majesty's Judiciary.

Appeal: Helen John and Anne Lee: York Crown Court, 2 – 5 September 1997

The Court was obliged to examine the appellants' defence accusation that the Secretary of State for Defence acted in 'bad faith' to protect and support illegal activities at Menwith Hill (the UK Ministry of Defence was the prosecutor not the defendant).
The judge rejected the argument on the grounds that the appellants were denied the right to question the Defence Secretary in the Courts about his actions. He is protected by 'Parliamentary Privilege'. The appellants won the case not on the 'bad faith' argument, but on the fact that the Defence Secretary acted ultra vires - beyond the statutory powers of his office.

In his Judgment issued on 5 September 1997: the late Judge Jonathan Crabtree stated:

"It is said that wholesale breaches of the Interception of Communications Act 1985 and of the European Convention on Human Rights must be going on [at Menwith Hill]…on the face of it, it rather looks as though Mrs Baird [Barrister] may be right in this contention…as a matter of law, the fact that some sort of illegality may be going on at a military base is not our concern. An illegality of some kind is doubtless going on...'

Under the cover of 'national security' the UK Government may impose a Public Interest Immunity Certificate to block disclosure of any prima facie evidence likely to be produced in Court, exposing the operations of the US Bases. Judge Crabtree attempted to prevent the presentation in Court of a statement by British Telecom – only to acknowledge that his efforts had been pre-empted by disclosure on the Internet.

The trial was a flagrant breach of Magna Carta: '*To no one will we sell, to no one deny or delay right or justice'*. King John, Runnymede, 1215.

The Local Government Authorities: abuse of Judicial Process:
The collusion between the US Bases and the local Council authorities is illustrated by the following example:

North Yorkshire County Council v WoMenwith Hill Women's Peace Camp women:
Eviction Hearings: Divisional Court: November 1997 – July 1999:

February 5th 1999:
It emerged during cross-examination of the North Yorkshire County Council 's Chief Highways Maintenance Engineer, who was under oath, that all documentary evidence relating to the local authorities' collusion with Menwith Hill had been deliberately withheld from the Court and the peacewomen respondents.

The judge, Hooper J, immediately adjourned the trial and ordered 'discovery', within one week, of all such correspondence. The Council 'discovered' 61 (sixty-one) relevant documents, which was still a limited disclosure. The correspondence revealed that the instigators of the eviction proceedings were the Menwith Hill Station authorities and that the Council Officers had discussed the possibility Menwith Hill making a financial contribution to the costs. (As there were five hearings in the High Court over a period of 20 months, the costs amounted to a substantial sum, believed to be in excess of £30,000).

The peacewomen submitted further affidavit arguments asserting that the national and local governments are fully aware of the illegal operations at Menwith Hill. The North Yorkshire County Council was thus guilty of bringing a case 'with unclean hands', by their covert unlawful collusion with the US National Security Agency in command of Menwith Hill.

This argument did not affect the Judgment.

Although the High Court had also to examine the peacewomen's right to protest, as enshrined in the Human Rights' Act 1998, the right to live outside Menwith Hill was not upheld and the Peace Camp was evicted on 19 August 1999.

In defiance of the High Court Injunction ordering peacewomen not to reside outside Menwith Hill, Helen John re-established the Women's Peace Camp on 24 May 2004.

- **Maintaining the Secrecy: the Environmental Impact**

Considerable finances and resources are diverted from investment in the UK environment and expended to maintain the secrecy of the US Bases' operations. It is not possible for members of the public to calculate the UK Government's contribution to the support for the US Bases provided by the Security Services and the Government Communications Headquarters. It is assumed to amount to hundreds of millions of pounds.

Some indication of Britain's commitment has been revealed by major exposures, over the past 20 years stripping away the layers of secrecy. They include:

- *The Unsinkable Aircraft Carrier*, Duncan Campbell, 1984
  (The definitive research into the US Bases).

- *The Hill*, TV programme produced by Duncan Campbell, 1993
  (Based partly on information amassed from perusing Menwith Hill's garbage).

- *Uncle Sam's Eavesdroppers*, TV programme produced by Richard Saddler, 1998
  (Duncan Campbell exposed that US Missile Defence components were being installed in Menwith Hill)

- *Interception Capabilities 2000*
  (Report presented by Duncan Campbell to the European Parliament's Committee of Inquiry into the implications for Europe of the US controlled ECHELON interception network).

- *Report of the European Parliament*, 5 Sept 2001
  (The EP made recommendations that the British and German Governments implement oversight and monitoring of the USA's communications' interception activities).

- Lots of articles published in the press – too numerous to mention.

- **Extra-Parliamentary Protest Activity: the Environmental Impact**

The effectiveness of 'single-issue' pressure groups' political activity, especially when it succeeds in changing attitudes, and thus policy decisions, at national and local government level should be a prime consideration for the Missile Defense Agency. For example, the Greenham Common Women's Peace Camps were instrumental in the decision to cancel the land-based, nuclear-armed Cruise Missile programme – as a consequence of which the US Base closed and environmental restoration work is underway.

The Yorkshire CND website http://cndyorks.gn.apc.org carries a comprehensive overview of the many different campaigning strategies deployed in opposition to the US Bases. All of them, including the non-violent civil disobedience actions, such as blockades, have an immediate impact on, and by influencing policy, the potential to change the environment.

The influence for change these opposition campaigns have achieved is difficult, if not impossible to assess, yet it is evident that changes in attitude have occurred and that they directly result from the presentation of an alternative viewpoint (e.g. the media now routinely describes Menwith Hill as 'US Spy Base').

One example will serve to illustrate:
In early 2001 approximately 200 people sent representations to the Harrogate Planning Department objecting to a development on the grounds that it was intended for US Missile Defence.

Because the Planning Application did not go before the elected Councillors, the first they knew of the plans and the objections was when it was reported in the Press that campaigners had approached a local Member of Parliament, who had then raised it with the Secretary of State for Defence.

In consequence Harrogate Council's Chief Executive, on behalf of the Council, wrote to the Prime Minister to insist that the Council be kept fully informed of the implications of such developments. The Council demanded further information about the implications of Menwith Hill's US Missile Defense role for the local community. In October 2001, Councillors and Executive Officers from Harrogate Borough and North Yorkshire County Councils were invited to attend a meeting with top Civil Servants at the Ministry of Defence in Whitehall, London.

The Council representatives were given blatant propaganda assurances that Menwith Hill is considered to be of the highest importance for the UK's national defence. The Minister of State for the Armed Forces repeated verbatim parliamentary and public statements his predecessors have issued. These assured the local authorities that Her Majesty's Government is aware of all activities taking place at the Bases: that UK personnel are integrated at the highest level and that the Bases are not engaged in anything inimical to British interests.

Tony Benn, a former Cabinet Minister, as Secretary of State for Energy at the highest level of responsibility for the nuclear power programme, stated that government Ministers are the 'elected ignorant' – so little 'sensitive' information was divulged to him when in Office.

US Missile Defence: an unpopular programme

British public opinion has changed radically as a result of the publicity generated by the anti-'Star Wars' campaigns. An opinion poll conducted in the summer of 2001 revealed that nearly 70% of the British people opposed 'Star Wars'. At the same time 278 Members of Parliament signed an Early day Motion calling for a full debate in the House of Commons.

Recent polling indications suggest that the opposition is growing.

DC_E0355

Johnson, Kathryn

From: Filson Glanz
Sent: Tuesday, November 16, 2004 10:59 AM
To: mda.bmds.peis
Subject: Comment on MDA Draft Programmatic Environmental Impact

Dear Sir/Madam:

This is a letter for the record in comment on the MDA PEIS.

It is my opinion that there is absolutely no way that we can accept "Alternative 2, missile defenses with space-based weapons." This is just too dangerous and a major risk to our democracy and the stability of the world.

We are also not very happy with "Alternative 1, missile defenses without space-based weapons." This alternative also will destabilize world weapons systems manufacture and deployment and lead to dangerous systems that can get into hands of empire builders or madmen bent on ruining the earth for us all.

Alternative 3, "No Action," which might seem like a logical out for those wanting to suppress this race to destruction, seems to leave things as they are - i.e. would allow continuation of the present programs which we are against! So the PEIS should be rewritten to allow another alternative: Discontinue all work on such systems, and work on getting cooperation throughout the world on disarmament.

Space based systems will most likely require nuclear energy in space and that would lead eventually to environmental disaster. or at least more widespread nuclear material throughout the earth biosystems.
This is not a good prospect for the survival of life on earth.
Furthermore, defensive space based systems can easily be used for offense; this is equally dangerous. It could also lead to control of space and the world by one country or controlling interest. And although it is evident that the Pentagon has for many decades wanted to do just that, and probably has a secret such goal, it is not what the people of the USA should allow their government to do in the interest of life on earth.

Furthermore, the cost of researching and building these systems is extremely high, and the money should be used to prepare for the coming resource depletion: fossil fuels, water, soil, air, and other resources we need to survive. That preparation will necessarily include bringing up the level of living standard of others on earth so that they will want to reduce their number of offspring and thereby stabilize the earth's population. That is on top of all the other things that need to be done: find new energy sources/systems, replacement for dwindling mineral resources, cleaning up of pollution in our air, water, soil, and organic systems.

All in all, although I realize and understand the logic of wanting impenetrable defenses, the survival of life does not depend on those; instead it depends on all countries and peoples of the earth cooperating on bringing our use of earth's resources under control so all can live a comfortable and safe life on earth. For too long the people of this country and of the world have allowed the military mentality - a kind of mocho growing up mentality - to dominate the agendas of the earth. Of course some military is necessary as a safeguard, but it has been way overdone. We must slowly and carefully get back to a rational approach to living at peace on the earth. And to start we must not continue to expand these MDA programs.

Thank you for including these comment in the record. I wish more people would think about the direction we are headed in these programs.

Sincerely, Filson H. Glanz

DC_E035

DC_E0363

Johnson, Kathryn

From: Sue Koger
Sent: Tuesday, November 16, 2004 3:50 PM
To: mda.bmds.peis
Subject: Pentagon Star Wars Plan

As a physiological psychologist, I am deeply concerned about the environmental and public health impacts of the Ballistic Missile Defense System, and wish to comment on the Draft Programmatic Environmental Impact Statement (PEIS).

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In particular, I am concerned about the hazardous waste associated with the system. For example, perchlorate from rocket fuel has already contaminated rivers and ground water, and can find its way into milk supplies (e.g., as has occurred in Texas). Like other toxins that act as endocrine disruptors, perchlorate can interfere with thyroid hormones and disrupt pre- and post-natal brain development, resulting in reductions of IQ and attention, mental retardation, hearing loss, and defects in speech and coordination. Seventeen percent of children suffer from developmental and learning disabilities, and as many as 25% of those disabilities are due to the effects of environmental toxins either acting alone or in combination with genetic and other environmental factors.

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Certainly, those individuals (often consisting of minority ethnic groups) and non-human species who live on or near test sites are at particular risk, and this issue is not sufficiently addressed in the PEIS. Finally, it would be environmentally catastrophic if these weapons were ever actually used in war. The hazards of use, including high altitude nuclear explosions, are not discussed in the PEIS but should be addressed. .

Weaponry escalation only serves to undermine security by creating new enemies and furthering fear and distrust. I thus urge you to oppose continuation of this development plan. Thank you for your time.

<>Susan Koger, Ph.D.

DC_E0366

Johnson, Kathryn

From: Dale Nesbitt
Sent: Tuesday, November 16, 2004 4:51 PM
To: mda.bmds.peis
Subject: COMMENTS ON PEIS FOR BMDS

Subject: Comments on the PEIS for the BMDS

From: East Bay Peace Action

to. MDA BMDS PEIS, c/o ICF Consulting

(1) The most fundamental flaw in the logic behind this program as outlined in the PEIS is that rather than enhancing our security it is highly likely to decrease it. Recent events really should make this obvious even to the neocons. Why is North Korea working so hard to build more nuclear weapons? Why does Iran appear to be working toward the capability of building nuclear weapons? Why are a number of countries developing rockets with longer ranges and to carry heavier loads? Why does China appear to planning to modernize their missiles (now liquid fueled?). We have no doubt that the most basic reason is for DEFENSE against this extremely provocative planned Ballistic Missile Defense System. Unless convincing rebuttals can be made to the above this entire program should be stopped.

(2) Beyond the question of the BMDS making us less secure it will also either bankrupt this country completely or at least divert badly needed monitory AND TECHNICAL resources from pressing human needs.

(3) In addition the BMDS program can not avoid causing serious environmental harm to an environment that is already badly stressed.

Of particular concern is with the spaced based proposals, they obviously need large amounts of power and we are well aware of the development work already going on to develop fission nuclear power plants for use in space. This is fundamentally a crazy idea. We dare anyone to prove otherwise!

(4) Calling this system a 'defensive' system in Orwelling double speak, it is and can only potentially be effective as an offensive system. Why not be honest and tout it as such. Some publications, such at the Space Command's Vision for 2020 clearly states that a space based system would be used to"deny other nations the use of space" IS THAT DEFENSIVE OR OFFENSIVE ? Why wouldn't other countries see it as offensive and a further attempt by the U.S. to dominate the rest of the world.

(5) For all of the above, and many more, we believe that the only acceptable alternative is for NO BALLISTIC MISSILE SYSTEM AS OUTLINED IN THIS PEIS. Note that does not mean the 'no action alternative' IT MEANS NO PROGRAM.

(6) The positive alternative would be a very vigorous effort to lead the entire world into international cooperation to eliminate all weapons of mass destruction and to forever to prohibit any weaponization of space.

Submitted via email by Dale Nesbitt for East Bay Peace action. This statement approved by the EBPA board on 11-11-04.

EBPA, B. Brown, Chairperson

DC_E0373

Johnson, Kathryn

From: Anita MASON
Sent: Tuesday, November 16, 2004 7:26 PM
To: mda.bmds.peis
Subject: "Star Wars"

The proposals for missile defence are dangerous and misleading. To describe such a system as "defensive" is disingenuous: it is a shield, and the use of a shield is to protect the wielder of a sword. Whether or not this is the real purpose of the missile defence system is irrelevant: it will be seen as such by other nations who have reason to fear the might of the USA, and will respond by developing their own weaponry in such a way as to get round the shield. There will be an arms race, in other words. In a world already thoroughly stocked with nuclear weapons, nothing is more calculated to provoke a disaster.

The idea of the domination of the earth from space, of which "Star Wars" is a component, is morally quite unjustifiable and in fact monstrous. It offends one of the most profound human feelings, the association of the sky with spirit. I do not imagine, however, that such considerations weigh with military planners.

I do not want to live in a world in which missile so-called defence is a reality, and I do not want my country, in which there are quite enough American military bases already, to host missiles, radars and communications systems for it. I do not believe that having them here will contribute to our security one whit, rather the reverse, and I repudiate my government's endorsement of the scheme. I believe that most British people would agree with me if they were in possession of the facts, but great care is taken to ensure that they are not. This vital issue has never been debated in Parliament.

Since it appears that "no action" in this context means "carry on with the plan", the three alternatives being considered by PEIS are all unacceptable. "Star Wars" in any form is destabilising, will eat up huge amounts of money that are needed for education, health care and the alleviation of poverty, will further distort the budget not only of the USA but of many other nations in favour of military spending and thus will make more likely a preference for military as opposed to peaceful solutions, and will only worsen the pollution and destruction of the planet by military-related industry and the cluttering up of space with bits of debris. No-one can have had a worse idea than this for many years.

Anita Mason

DC_E0376

Johnson, Kathryn

From: Bob Howd
Sent: Tuesday, November 16, 2004 8:02 PM
To: mda.bmds.peis
Subject: MDA PEIS Form Responses

name=Robert Howd
org=Office of Environmental Health Hazard Assessment
address1=1515 Clay St., 16th floor
address2=Oakland, CA 94612
comments=In the draft Programmatic Environmental Impact Statement for the Missile Defense System (1 September 2004), I would like to point out incomplete and misleading statements about perchlorate toxicity and standards in the bottom paragraph on Vol. 1, p. 4-56. This discussion provides the viewpoint of the DoD and the Perchlorate Study Group, an Industry Workgroup, on perchlorate toxicity, but ignores all risk assessments conducted by actual risk assessment agencies. The U.S. EPA has been evaluating perchlorate toxicity for years, in association with several defense agencies (as stated), and has released a draft risk assessment which proposes a drinking water equivalent level of 1 ppb.
The State of California Office of Environmental Health Hazard Assessment has published our risk assessment which estimates a health-protective level of perchlorate in drinking water of 6 ppb. The State of Massachusetts has recently released their evaluation with a recommended drinking water level of 1 ppb to protect pregnant women and fetuses (or other sensitive sub-populations), and 18 ppb for healthy adults. The U.S. EPA guidance applicable to water contaminant plumes emanating from industrial and DoD sites has used a standard of 4-18 ppb for several years.

To not consider and apply these relevant and applicable standards to the evaluation of potential environmental impact of the deployed missile systems seems to me to be putting both the DoD and the public at risk, both from legal liability and potential chemical hazards. I recommend that this section of the report, and any financial and toxicological calculations based on it, be revised to include the viewpoints expressed by the regulatory agencies whose job it is to regulate the public and environmental exposure to perchlorate. Acknowledging these opinions need not wait for the finalization of the U.S. EPA's current draft risk assessment for perchlorate, currently under review by the National Academy of Sciences, nor the promulgation of the California Maximum Contaminant Level for perchlorate in drinking water, scheduled for 2005.

Thank you for consideration of these comments.

Robert A. Howd, Ph.D.

The above comments represent my personal opinions, and have not been reviewed or approved by OEHHA prior to submission.

DC_E0380

Johnson, Kathryn

From: Darien De Lu
Sent: Tuesday, November 16, 2004 11:46 PM
To: mda.bmds.peis
Subject: Comments on the BMDS PEIS

Here are additional comments on the BMDS PEIS

1) In category after category, case after case, the PEIS repeatedly discounts the impacts of toxic substances resulting from and involved in activities at every level - manufacture, launching, use, etc. - by contending that the toxic substances will have no impact because they will be handled in accordance with existing law and guidelines. Such a blanket contention flies in the face of current experience with toxic substances. Many factors result in the legal guidelines failing to insure public and environmental safety when toxic substances are involved.

The report fails to entertain the possibility of accidental spills and discharges, whether in the transportation stage or as a consequence of mishaps at other stages. Additionally, the report ignore our experiences in which we have repeatedly experienced toxic consequences from currently legal uses of chemicals. The claim that there will be no toxic impacts by merely following existing handling rules is implausible.

Moreover, new discoveries about the minute amounts of substances that can still have a deleterious effect are continually forcing us to readjust safety standards. To initiate the massive undertakings proposed within the BMDS without making any attempt to mitigate the impacts - readily imaginable based on the evolving nature of toxin safety understandings - is unrealistic.

2) The PEIS completely ignores the well known environmental impacts of radiation. It does so by maintaining the transparent fiction that an effective BMDS can be implemented without resorting to the use of nuclear war heads.

Current research with BMDS prototypes provides scant basis for the belief that lasar or kinetic weapons will serve to eliminate target warheads. A realistic PEIS for BMDS must include a full and detailed consideration of the environmental impacts of nuclear weaponry. Such an assessment must address the entire nuclear cycle - production and manufacture as well as decommissioning and waste storage.

Submitted by Ms. Darien De Lu, .

DC_E0387

Johnson, Kathryn

From: Neil Kingsnorth
Sent: Wednesday, November 17, 2004 6:39 AM
To: mda.bmds.peis
Subject: Yorkshire Campaign for Nuclear Disarmament comments on the Draft Programmatic Environmental Impact Statement for the Ballistic Missile Defence System

Dear Sir/Madam,
Please find attached the Yorkshire Campaign for Nuclear Disarmament's comments on the Draft Programmatic Environmental Impact Statement for the Ballistic Missile Defence System. I would appreciate ackowledgement of receipt of this paper.

Best wishes,

Neil Kingsnorth

Yorkshire Campaign for Nuclear Disarmament
22 Edmund Street, Bradford, BD8 7AY, UK
tel. +44 (0)1274 730795 / email info@yorkshirecnd.org.uk
Web: www.yorkshirecnd.org.uk

Yorkshire Campaign for Nuclear Disarmament comments on the Draft Programmatic Environmental Impact Statement for the Ballistic Missile Defence System

Introduction
The Yorkshire Campaign for Nuclear Disarmament is a regional wing of British CND and it specialises in Missile Defence issues. It is one the leading UK Non-Governmental Organisations campaigning on Missile Defence, with particular emphasis placed on the two Missile Defence bases in Yorkshire – Fylingdales and Menwith Hill (the latter is yet to be officially confirmed as a Missile Defence facility).

Given our considerable interest in Missile Defence and its implications for global and UK security and stability, Yorkshire CND welcomes the opportunity to present our comments on the Draft Programmatic Environmental Impact Statement.

We are disappointed however that the PEIS will only be undertaken for component bases in the United States and not for overseas bases integral to the system, such as Fylingdales. From our experience of talking to the residents close to the Fylingdales base, we are aware of a constant concern about its role in the "Son of Star Wars" program and a desire for more information and accountability from the developers of the system. The local population in the vicinity of this base has both environmental and security concerns regarding the base's role in Missile Defence that ought to be addressed in such a study. The same also applies for Menwith Hill – considered highly likely to play a key role as the Ground Based Relay Station for the Space Based Infra Red System - and these concerns will grow if the United States is granted permission to use the base for Missile Defence by the UK Government.

Furthermore, there exists a large, informed section of society, not necessarily within the vicinity of these particular bases, that is also legitimately concerned as to the potential impact on UK and global security as a result of the Missile Defence system. Despite the UK's involvement in the system this group too will not be represented by this study.

Yorkshire CND, along with many concerned UK groups, did present submissions to the UK Parliament Defence Committee in late January 2003 as part of their investigation in to the potential use of Fylingdales for US Missile Defence, especially as the Ministry of Defence has repeatedly stated that it does not consider that the UK was under threat from a missile attack. However, since the public consultation period declared by the Secretary of State for Defence at the time (one month over the Christmas holidays and parliamentary recess) was completely inadequate, it gave no real opportunity for local residents or the general population of the UK to voice their concerns on this important issue. We hope therefore that the PEIS will give due attention to the views and concerns of residents affected by Missile defence beyond the shores of the US mainland.

Despite the fact that the PEIS has currently declared that it will only consider component bases of Missile Defence based in the US, we will refer to the Yorkshire bases both in the hope that the PEIS will recognise the importance of expanding its remit to cover Missile Defence bases beyond the USA mainland, and partly because the concerns that surround these bases can be equally applied to their US-based equivalents.

UK position
The UK Government has already granted permission for the USA to upgrade the Early Warning Radar at Fylingdales so that it may play a role in the Missile Defence system. Concerned observers of Missile Defence developments expect a similar request for use of Menwith Hill to come from the US in the future. The base has purpose-built downlink and relay elements for the Space-Based Infra-Red System (SBIRS), which will be integral to the US Missile defence system if and when the SBIRS satellite network

is complete. It is also possible that the UK may host an X-Band Radar and/or Missile Defence interceptor missiles in the future.

Fylingdales
Fylingdales, and radars like it, present environmental concerns to the local population as a result of the possible harmful biological effects of the non-ionising radio frequency emissions from the radar. Whilst the radar beam itself projects 3° above the horizon, the beam releases leakage in the form of sidelobes. These sidelobes of pulsed low frequency radiation are the source of considerable anxiety to local residents. Such concerns are exacerbated by the obvious effects of the radar in the local area (such as car alarms being set off regularly for no apparent reason, car automatic locking systems being triggered and interference with radio and tape players in cars passing the base) and the knowledge that the similar Cape Cod radar base in the United States has seemingly significant cancer clusters in its vicinity (that has resulted a USAF supported study of the radar effects on health). In 2003 the then base commander of RAF Fylingdales confirmed to Yorkshire CND that the radar has "issues with leakage."

The paper "Is it Safe?" by Professor Dave Webb - Convenor of Yorkshire Campaign for Nuclear Disarmament – explains in more detail the environmental concerns over the radar radiation and it is attached as Appendix 1 to this paper.

Furthermore we would point out that the Fylingdales radar base is in the North York Moors National Park – a loved and protected area of the UK. It is already seen by many as an unsightly abomination cutting across the horizon of otherwise ancient and unspoilt moorland. An increased role for the base in a new, highly controversial global military network presents the potential for increased activity, expansion and increased policing, all of which will lead to environmental degradation of the moorland on which the base is situated and the surrounding countryside.

Menwith Hill
Menwith Hill overlooks but is excluded from the Nidderdale Area of Outstanding Natural Beauty. As with Fylingdales, it interferes with a region that has been specifically ~~pinpointed~~ as an area of special importance that deserves protection. The land the base is on would no doubt have been included in the area if it had not been already spoilt by the considerable military presence. Menwith Hill is again visible for miles around and is an inexcusable blot on an otherwise precious landscape. The base's continual expansion and glaring nightlights only further interfere with this area.

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Despite the base's contention that it is an RAF base, the base is in all reality run by the US military and it is famously unaccountable to the UK people. Thus, its environmental impacts are less controllable and have become considerable. As an example, although the base does present planning applications to the local council, that council has no power to disapprove them and the base can build whatever it desires, where it desires, with the local community only being able to express its concern and hope that the base commanders will take some notice. This situation has led to fervent expansion with little or no consideration for the impact on the local community or environment.

The discovery of a colony of rare feral orchids in natural wetland on the north-west of the Base by Anne Lee of the WoMenwith Hill Women's Peace Camp(aign), led to an investigation by one of the country's top orchid experts. This research did lead to the re-routing of a proposed high security fence and an agreement to conserve the orchids' site as a reserve. Such protection would not have been achieved if it were not for the discovery of a concerned citizen, since the base itself makes little effort to consider the environmental impact of its proposed developments.

Space
Missile Defence plans extend to the possible deployment of space-based weaponry and space-based weapons systems. It is crucial that the PEIS consider seriously the likely impact of space weapons deployment. The use of space weapons, for whatever reason, to attack or destroy objects outside of the atmosphere would produce space debris, changing the near Earth environment and would become a serious hazard to future space missions, even possibly preventing them from leaving Earth. At the speeds required to escape the Earth's gravitational pull, the impact of just a tiny object on a space rocket could be disastrous. Space-based conflict of any sort could add to this problem enormously and it is an issue that deserves serious attention.

Further to this, plans for weapons such as the space-based laser may eventually incorporate the use of nuclear power. The deployment of nuclear powered satellites could be environmentally disastrous with considerable risk of high-level pollution at the point of initial launch, when in orbit (from attack or accident) and (if and when the orbit decays) during re-entry into the Earth's ~~atmosphere.~~

Deleted: atmosphere .

The deployment of space-based weapons will also present the problem of increased global instability and a degradation of arms control efforts. Such deployments are likely to provoke other states to respond in kind with their own developments and deployments. With no sufficient legal system controlling the non-WMD weaponisation of Outer Space, weapons deployment and the threat of opponents interfering with vulnerable ~~systems,~~ could provoke a highly destabilising and dangerous space arms race. On top of this, space weapons deployment could provoke both horizontal and nuclear proliferation amongst states that are not capable of entering such a space weapons race but wish to respond to the threat.

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Despite the PEIS's claims, various weapons components deployed under Missile Defence will have offensive capabilities, taking war-fighting to a whole new level, quite literally. Such statements are justified by statements from official US sources, such as the US Space Command's "Vision for 2020", their "Strategic Master Plan FY06 and Beyond" and the USAF Doctrine Document 2-2.1 "Counterspace Operations".

Nuclear proliferation and a space arms race would have considerable, long-lasting effects on arms reduction efforts and international stability and, from the perspective of the PEIS, present a genuine threat to the Earth's environment through the production of nuclear weapons, the creation of space debris and the possible use of nuclear weapons.

Other issues
The exhaust plumes of missile like the Missile Defence interceptor create considerable toxic pollution which is having an under-rated and very important long-term effect on the Earth's Ozone Layer. Such effects are to be seen increasingly over the coming years and could have a massive environmental and social impact in the near future. Missile Defence developments will expand the amount of rockets being sent into space and exacerbate this problem.

Yorkshire CND considers it worth emphasising too that the Missile Defence system is currently costing the US taxpayer something in the region of $9 billion every year and that this is likely to rise as deployment of more and more complicated, high-tech systems takes place, alongside maintenance of the current set-up. This amount of money could be diverted so that further cuts in health care, education and public services budgets would not be necessary. The money could be used too for broader, longer-term, more realistic, sustainable security efforts such as the cancellation of third world debt or the provision of food, water, shelter and education to some of the world's poorest people.

Yorkshire CND asks that our concerns be taken seriously and considered properly. The PEIS has offered itself three options, none of which is sufficient. As we understand it, the "no action" option simply allows for no change in current developments and the continuation of the project. If this is to be the ultimate step that the MDA is prepared to take then it implies a bias towards the outcome of this PEIS study by not allowing for the possibility that the Missile Defence system is too environmentally destructive to continue with.

The Missile Defence system is indeed a hugely expensive, dangerous and, on many levels, environmentally destructive system that is absorbing funds that could be put to better use in the challenge of global security. On these grounds, it should be halted.

Yorkshire CND would appreciate notice of receipt of this paper and to be kept up to date with developments relating to the PEIS.

APPENDIX 1

Fylingdales - Is the Radar Safe?
By Prof. Dave Webb – www.cndyorks.gn.apc.org/fdales

An Information and Safety Booklet given to contractors, new personnel and visitors to the Phased Array Radar (PAR) at RAF Fylingdales in North Yorkshire tells them to keep their mobile phones switched off to protect them from damage from RF power. The booklet also warns that there is a risk of induced RF power causing a spark between car and metal petrol cans and that remote car locking devices may not function. However, it doesn't mention much about the risk to health of visitors or local residents.

RAF Fylingdales is in the North Yorkshire Moors National Park and has been the home of a US Ballistic Missile Early Warning System (BMEWS) since the Cold War days of the 1960s. The base is run for the US by the RAF and is one of the 3 stations in a chain linked across the North Atlantic. The other stations are Thule in Greenland and Clear in Alaska and the 3 stations provide (in conjunction with the Defense Support early warning satellites) a Tactical Warning/Attack Assessment directly to the US Joint Chiefs of Staff.

The 40-meter high truncated pyramid that forms the PAR has 3 faces each containing an array of 2,560 aerials, transmitting at 420-450 MHz with a total mean power output of 2.5 Megawatts a range of around 3000 miles and is able to operate over a full 360°. The main radar beam is directed to be at least 3° above the horizontal, however side lobes can reach the ground.
At the time of the PAR upgrade to the system (previously it consisted of three mechanically steerable dishes housed in radomes) in 1993, an ElectroMagnetic Radiation (EMR) Survey of the area surrounding Fylingdales was commissioned by the Nuclear Free Local Authorities [1] . The survey was an extension of an earlier report produced in the summer of 1991 and used 23 measurement sites, including moorland paths and tracks, roadside locations and habitations. The survey found maximum field values of about $10Vm^{-1}$ which were in fact quite close to the currently accepted international standards developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) reference levels of $28\text{-}29Vm^{-1}$ for the Fylingdales frequency range [2] . The MoD says that "UK safety thresholds are based on NRPB guidelines and not those of ICNIRP" [3] . However, the European Council Recommendation 1999/519/EC requires member states to implement ICNIRP and their power levels are more than ten times lower than NRPB in this frequency range [4] .

Also, there is some question as to the characteristics of the radar beam generated by the thousands of antennae on the PAR. Beams generated by conventional radar are in the form of simple waves, whereas the PAR beam is generated by many overlapping pulses that can strike a person thousands of times in a fraction of a second.

Some investigation into the accepted international standards is required in order to put these results into some kind of context. A recent report on the Physiological and Environmental Effects of Non-ionising Electromagnetic Radiation for the European Parliament [5] states:

"What distinguishes technologically produced electromagnetic fields from (the majority of) those of natural origin is their much higher degree of coherence. This means that their frequencies are particularly well-defined, a feature that facilitates the discernment of such fields by living organisms, including ourselves. This greatly increases their biological potency, and 'opens the door' to the possibility of frequency-specific, non-thermal influences of various kinds, against which existing Safety Guidelines – such as those issued by the International Commission for Non-ionising Radiation Protection (ICNIRP) - afford no protection. For these Guidelines are based solely on consideration of the ability of radio frequency (RF) and microwave radiation to heat tissue, and of extremely low frequency (ELF) magnetic fields to induce circulating electric currents in the interior of the body, both of which are known to be deleterious to health, if excessive."

The report points out that the frequency-specific sensitivity of living organisms to ultra-low intensity microwave radiation was discovered over 30 years ago in Russia and there the exposure guidelines are approximately 100 times more stringent that those of ICNIRP. It also notes that some symptoms have been reported in epidemiological studies involving humans, animals and plant life connected with a radar operating at 154-162MHz, with a pulse repetition frequency of 24.4Hz - at a location where the intensity of the emitted radiation is comparable to that typically found at 150m from a base-station. Additional effects include [6] :

- Depressed nocturnal melatonin levels in cattle [7] .

- Less developed memory and attention span (as well as decreased endurance of their neuromuscular apparatus) of children living within a 20 km radius of the radar, subject to a maximum exposure of 0.00039 W m^{-2}.
- A six-fold increase in chromosome damage in cows exposed to a likely maximum intensity of 0.001 W m^{-2}.

(The cited field intensities are estimated from information on the electric field intensity as a function of distance from the radar installation [8]).

The Fylingdales radar operates by emitting a series of pulses and additional, perhaps more serious, problems may arise at frequencies around 17 Hz. As mentioned in the STOA report, this lies in the range of beta brain-wave activity and is close the frequency of a flashing visible light that can provoke seizures in people with photosensitive epilepsy. It is also the modulation frequency at which *"there is a maximum in the expression of calcium ions from brain cells when they are irradiated with amplitude modulated, low intensity RF radiation over a wide range of carrier frequencies"* and *"any interference … could well undermine the integrity of the whole nervous system, although the extent to which this actually occurs is, at present uncertain, owing to a lack of the necessary research."* The pulse repetition frequency of the radar is thought to be 27 pulses per second (at least, this was the documented frequency of the previous system [9]) and it is not known whether there are any similar effects at or around this frequency that need to be examined closely.

Concerns about the effects of the electromagnetic radiation effects due to the radar were expressed by Yorkshire CND in its submission to the House of Commons Defence Committee on the upgrading of Fylingdales for the US Missile Defense Program (*See First Report of Session 2002-3 Volumes I & II, HC 290-I and HC 290-II, published 29 & 30 January 2003*). In response the MoD published for the first time results of emr levels measured around the base from 1991. These records show typical recorded levels of around 0.230 mW/cm^2 which is comparable with the reference level suggested by the ICNIRP of 0.225 mW/cm^2 for 450 MHz radar signals.

Radar power levels can be quoted as field strengths (V/m) or as power densities (mW/cm2). It is general practice amongst those who want to show how low their emissions are to quote in power density since this is proportional to the square of field strength, and therefore levels that are, say, ten times lower than the limit in volts per metre will be 100 times lower if expressed in mW/cm^2.

The maximum recorded levels are around 0.869 mW/cm^2 (location 26, Top of outside perimeter fence). This is 33% of the NRPB power density level or 58% of the NRPB electric field level. However, it is 4.3 times the ICNIRP power density level or more than twice the ICNIRP voltage level.
In the report the MoD state:

(para 4 on p. Ev60) "It should be borne in mind that UK safety thresholds are based on NRPB guidelines and not those of ICNIRP..."

In fact the UK has failed to implement legislation based on the European Council Recommendation 1999/519/EC, which requires member states to implement ICNIRP safety thresholds (which are ten times lower than NRPB in the frequency range relevant to Fylingdales).

Cape Cod
In April 2001 the US Air Force agreed to conduct "time-domain measurements" on a similar radar installation (known as PAVE PAWS – Phased Array Warning System) at Cape Cod in the US. Local residents there are concerned about the radar because the area has some of the highest rates of cancer in the state. From 1993 to 1997, nine of the Cape's 15 towns had breast cancer rates at least 15 percent higher than the rest of the state. [10]

Richard Albanese, an Air Force scientist for more than 31 years, and others (including Professor Kurt Oughstun) are worried that the radar's phased wave fronts affect human tissue in ways that aren't yet understood. Albanese is reported as suggesting that the radar station should be shut down or moved and that *"I have to go with the concepts of the medical profession, which say that humans shouldn't be exposed to physical or chemical environments that have not been tested'* . in the worst case the PAVE PAWS station could be causing a 21 percent increase in 'malignant disease' rates, a risk that would appear to warrant more study. *"In my experience working with military personnel ... misconceptions and*

errors tend to become entrenched in the organizational setting and do damage to medical practice" he wrote. [11]

In a presentation given in February 2002 at the start of a series of experiments to measure the PAVE PAWS radar, Albanese said he has conducted animal testing that has shown animals suffering harm when exposed to phased array radar at levels 1,000 times below the current electrical health standards. [12] The question remains "why has the Air Force classified much of Albanese's work?"

X-Band Radar
There may be additional problems. The UK government has already agreed that Fylingdales can be upgraded for use in the US missile defense ("Son of Star Wars") system and it is still possible that a new high resolution phased-array X-band radar (XBRs) using high frequencies (5.2-8.5 GHz) and advanced radar signal processing technology may eventually be employed at Fylingdales to improve target resolution [13] . These systems emit a series of electromagnetic pulses over a 50° field of view in azimuth and elevation, and can be rotated to track targets from any direction. When fully operational each system will include a radar mounted on pedestal, will need approximately 30 to 60 personnel to operate and will encompass an area of approximately 7 hectares (17.46 acres) for the radar alone and would need to be surrounded by a 150 m (500-foot) controlled area. [14]

XBRs have an average power of 170 kW and an antenna area of 123 m^2, which means a power-aperture product of about 20 million, but they usually incorporate a "thinned" array of only 1/5 of the total possible number of aerial elements (around 81,000) decreases the gain by a factor of 5. In this case more energy goes into the radar beam sidelobes but does produce a narrower beam and provides greater tracking accuracy.

Questions have been raised regarding the possible danger to the health of people living close to these installations. The BMDO insists that the microwave leakage from these high power radars is safe – but independent investigations into possible health hazards need to be made.

The XBR BMDO fact sheet [14] states that "The exposure limits established by [the US standard] ANSI/IEEE C95.1 1999 are used to ensure that public health will not be impacted by EMR emitted from the XBR".
Two major exposure environments are defined: inside and outside a controlled area of radius 150m. Security personnel would control the area to prevent any unauthorized access. It is claimed that outside the controlled area the EMR will be no higher than the power density levels specified in ANSI/IEEE C95.1 1999. The US Missile Defense Agency state that:
"There is a possibility that EMR may effect television reception out to a distance of 4 kilometers (about 2.5 miles) from the XBR and that occasional static may occur in some radios out to 7 kilometers (about 4.3 miles) from the XBR."

Concluding remarks
The radar at RAF Fylingdales in North Yorkshire gives rise to a number of concerns:

- The effects on health from the electromagnetic radiation need further investigation – a fresh EMR survey of the site is needed to update and re-examine the data collected 8 years ago – especially as the accepted international standards are being challenged in the US and by those concerned about the health effects of mobile phone masts etc.;
- The Ministry of Defence needs to explain why it insists on referring to NRPB guidelines rather than those of the ICNIRP (recommended by the European Union). Could it be because the Fylingdales radar fails the ICNIRP standards but not those of the NRPB ?
- More studies are needed on the extent and effects due to the low frequencies around the pulse repetition rate (27 Hz) as these may be particularly harmful to biological organisms;
- The introduction of a proposed X-band radar would mean an increase in EMR levels possibly resulting in an increased danger to local inhabitants and wildlife.

Much more research is required into the extent of EMR pollution at Fylingdales, the effects of these EM fields at the frequencies encountered and a much more in depth study of the health effects of the proposed X-band radar system.
See also: reports on BBC program - "Health Fears Over RAF Radar"

Notes:

[1] "RAF Fylingdales EMR survey: second phase" by Tim Williams, Elmac Services, August 2, 1993
[2] See "Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (up to 300 GHz)" from ICNIRP at http://www.icnirp.de/documents/emfgdl.pdf
[3] See the House of Commons Defence Select Committee Missile Defence report (Vol.2), Feb 2003
[4] Council Recommendation of 12 July 1999 on the limitation of exposure f the general public to electromagnetic fields (0 Hz to 300 GHz) (1999/519/EC)
[5] "The Physiological and Environmental Effects of Non-ionising Electromagnetic Radiation", by G.J. Hyland, Private Treaty No. EP/IV/A/STOA/2000/07/03.
[6] Science of the Total Environment; Issue No 180, 1996.

[7] "Study of Health Effects of Short-wave Transmitter Station at Schwarzenburg", by E.S. Altpeter et al., University of Berne, Inst. for Social & Preventative Medicine, August, 1995.
[8] "Measurement of the intensity of electromagnetic radiation from the Skrunda radio location station, Latvia", by T. Kalnins et al, Science of the Total Environment 1996, 180:51-56
[9] Jane's Radar and Electronic Warfare Systems, Second Edition, page 62, 1990-1.
[10] "Radar tower plan rekindles fears" by Richard Higgins, The Boston Globe, 5 March 2001
[11] "Making (Radar) Waves" by Ross Kerber, The Boston Globe, 2 July 2001
[12] "Measured Response" by Kevin Dennehy, Cape Cod Times, 28 February 2002
[13] The original plans for US Missile Defense did include a ground based XBR system at Fylingdales, but General Kadish of the US Missile Defense Agency has recently suggested that future XBRs might be based at sea rather than on land.
[14] "X band radar Fact Sheet" from the BMDO - was originally at www.acq.osd.mil/bmdo/bmdolink/pdf/jn0019.pdf but now removed - a copy can be found at www.cndyorks.gn.apc.org/bases/xbandradar.pdf

Johnson, Kathryn

From: Jonathan Parfrey
Sent: Wednesday, November 17, 2004 12:35 PM
To: mda.bmds.peis
Subject: comments from concerned California residents

November 16, 2004

MDA BMDS PEIS
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031
(sent via web-page)

Attention: Public Participation Officer

Dear Sir or Madam,

This letter is to transmit comments on the draft Ballistic Missile Defense System Programmatic Environmental Impact Statement, dated September 1, 2004.

I write on behalf of the Los Angeles chapter of Physicians for Social Responsibility, the American recipient of the 1985 Nobel Peace Prize. Founded in 1980, the organization has approximately 5,000 members in Southern California. The two main principles of our organization are to prevent the use of weapons of mass destruction and preserve the environment. It is out of concern for these two tenets that we write.

CROSS-CUTTING ISSUES

With respect to what the overall BMDS actually could entail, the PEIS is so broad and generalized that it is not possible to know what is covered by the overall BMDS PEIS and what isn't. For example, nuclear-tipped interceptors have been discussed by MDA officials but are not addressed in this PEIS. The extent and limitations of this PEIS should be clearly stated.

Communities most impacted by BMDS have been largely excluded from the environmental review process. For example, communities near Vandenberg AFB will disproportionately bear the burden of the proposed 515 launches over the next ten years. And, the PEIS has not sufficiently dealt with the effect of cumulative effects in Southern California, as many of the region's contractors are working on the weapon system. Simply, there needs to be additional hearings in potentially impacted areas of the nation.

The timeline to release the Final PEIS – cited on the MDA web-site and announced at the October 19, 2004 public meeting – a mere two to six weeks after the comment period deadline portends that MDA will not fully consider and respond to public testimony. PSR-LA emphatically suggests that MDA take the time to consider and respond in full to all comments and critiques.

NO ACTION ALTERNATIVE

DC_E0395

What is called the “No Action Alternative” is not adequate under NEPA and does not describe a scenario where no action is taken. Rather it describes a situation where the Missile Defense Agency would continue existing development and deployment of missile defense systems unabated. Under the “No Action Alternative” individual systems would continue to be tested and deployed except for integrated system-wide tests. This is hardly no action and would permit an indeterminate missile defense program, especially since, as explained in the draft, “There are currently no final or fixed architectures and set of requirements for the proposed BMDS.” Even if MDA agreed to the “No Action Alternative,” it would not find its actions constrained for the foreseeable future. The MDA needs to develop new alternatives which meet the intent of NEPA.

Most crucially, the “No Action Alternative” strangely links world events, policy objectives with environmental considerations; unprecedented in an environmental document which is supposed to be grounded in the science of risk assessment. The PEIS reads:

> “The decision not to deploy a fully integrated BMDS could result in the inability to respond to a ballistic missile attack on the U.S. or its deployed forces, allies, or friends in a timely and successful manner. Further, this alternative would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress.”

Through the MDA’s own volition, the document goes beyond environmental considerations and opens a Pandora’s Box of analyzing the state of American security, the potential for missile attack, and the appropriate policy responses. Therefore, it is now MDA’s responsibility to respond to all public comment on threat and policy, even those challenging the rationale for missile defenses.

Now that the Pandora’s Box is open on policy, the Missile Defense Agency should, for example, make the case that nuclear deterrents no longer suffice, and MDA should substantiate why BMDS is the preferable security strategy over other Alternatives by which America might be kept safe, such as through United Nations IAEA inspections, international controls on missile sales and missile technology, or diplomacy.

If the agency choices to maintain the current “No Action Alterative” – which we do not support – the final PEIS would need to offer a realistic analysis (and timeline) of missile threats against the American homeland, nor fudge the distinction between theater and strategic threats.

Further, the “No Action Alternative” would eliminate systems integration testing, the very testing that would be needed to demonstrate that a layered missile defense system, as ordered by the President, can work. Elsewhere in this PEIS the President's direction is cited as a reason why no further change in the plan is being considered, but in the “No Action Alternative,” the President's direction is clearly negotiable.

Historically, missile defenses have been divided between battlefield-theater defense and strategic defense. All previous administrations kept these two aspects of missile defenses segregated. A fourth alternative could be to develop and integrate theater defenses while postponing defenses to strategic attack.

TESTING AND DEPLOYMENT

In the statement read by Mr. Marty Duke at the Public Hearing held in Sacramento on October 19, 2004, Mr. Duke said that if testing failed to show that the system worked, the system would not go forward. However, as you know, the system is already being deployed even though it has no demonstrated capability to work under realistic conditions. Accordingly, the environmental process described in this

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PEIS is not believable since the statement made by Mr. Duke on October 19 has already been nullified by the Missile Defense Agency.

SPACE-BASED INTERCEPTORS AND SATELLITES

With respect to space-based interceptors, the PEIS is silent about the fact that missile defense would for the first time weaponize space. While space is certainly militarized, it is not yet weaponized, that is, by deploying attack weapons in space, with the consequences of a new arms race in space. The PEIS does not adequately address the environmental impacts of the consequences of placing strike weapons in space. Also, the relationship between NFIRE and space-based missile defenses, alluded to in the PEIS, should be clarified.

The use of radioactive sources on missile defense satellites, either for surveillance, target tracking and target discrimination, or on space-based missile defense interceptors is not discussed.

The PEIS states that space-based interceptors could be placed in geosynchronous orbit: 35,786 kilometers above the Earth’s surface. To actually get a weapon from geosynchronous orbit to low-Earth orbit or even a lower trajectory of a missile within 20 minutes or half hour and do so accurately is physically impossible. Therefore the PEIS has mischaracterized this space weapon. Simply, any weapon placed in geosynchronous orbit could not be an anti-missile weapon. However such a deployment could be an anti-satellite weapon, an ASAT. The agency should then go through the process of trying the field this ASAT weapon on its own merits.

AIR-BORNE LASER

With respect to the Airborne Laser, the PEIS says that, “the ABL is currently the only proposed BMDS element with a weapon using an air platform.” This is not correct. The PEIS should also address another proposed BMDS element using air platforms, namely, interceptors fired from aircraft.

The PEIS does not present the total quantities of specific hazardous chemicals that would be carried aboard an ABL aircraft nor does it describe the total quantities of specific hazardous chemicals that would be stored on the ground at various test and training locations. In addition, the PEIS does not address the environmental impacts should those chemicals be spread over the land from an accident or aircraft crash, or jettisoned at low altitude in an emergency.

AEGIS BMD

Except for the largely historical discussion in Section D.3, the PEIS does not adequately describe AEGIS BMD operations, the large number of missiles involved, nor the locations where testing or training with those ships and missiles will be conducted, nor the environmental impacts of operational deployment with those ships or missiles.

KILL VEHICLE

The environmental impacts of the development, testing, training, and deployment of the proposed new, high-speed, Kinetic Energy Interceptors are not adequately addressed. In particular, the number and size of these large interceptors is not described nor are the types of propellants and chemicals involved.

GROUND-BASED INTERCEPTOR

A third interceptor site is mentioned in the PEIS but it’s location is not stated or described. More

DC_E0395

importantly, the environmental impact of BMDS operations at that third site are not addressed either. MDA officials have said that this third site could hold up to 20 ground-based interceptors and be bigger than the site at Fort Greely, Alaska. The environmental impacts of such as large operation should be addressed.

Thank you. We look forward to a response.

Sincerely,

Jonathan Parfrey
Executive Director

DC_E0401

Johnson, Kathryn

From: Victoria Samson
Sent: Wednesday, November 17, 2004 3:29 PM
To: mda.bmds.peis
Subject: Comment on draft BMDS PEIS

To whom it may concern,

I would like to raise the issue of the 3rd ground-based interceptor site, something which I believe has been completely overlooked in the draft Ballistic Missile Defense System Programmatic Environmental Impact Statement. There is no hard and fast information in this document which indicates where the 3rd interceptor site may be located. However, news stories this fall claim that the United States has been discussing with the United Kingdom the possibility of basing our interceptors on their territory. Alternatively, there are reports that Poland may be the host of the third site. Be that as it may, the draft PEIS gives no indication of where the third site will be, nor of the extent of its size. Presumably, if this document is to lay the groundwork for the missile defense network in its entirety, at least several of these alternatives would have to be examined.

Victoria Samson

Victoria A. Samson, Research Analyst

DC_E0402

Johnson, Kathryn

From: Catherine Thomasson
Sent: Wednesday, November 17, 2004 3:29 PM
To: mda.bmds.peis
Subject: Comments on behalf of over 800 members of Oregon Physicians for Social Responsibility
Importance: High

I am very pleased to be able to comment on the Ballistic Missile Defense System Programmatic Environmental Impact Statement (BMDS PEIS) on behalf of over 800 members of Oregon through the Physicians for Social Responsibility. I am delighted that a sense of system and control and oversight required by NEPA can be applied to this program as it does to other aspects of governmental plans.

I think the most important issue is that the BMDS PEIS does not contain a real No Action Alternative. Your No Action alternative which many people think is a good option really only states that the entire plan be implemented as already underway with only the exclusion of the new layered additions. A real No Action alternative, stops the implementation of the nuclear missile defense system.

This was the choice of President Clinton when he decided in September 2000 not to move forward with deployment because of technical uncertainties and unsuccessful flight tests. In 2003 the General Accounting Office in 2 separate reports raised serious questions about the ability to prove the system was functional. A separate non-governmental report by the Union of Concerned Scientists supported that position in 2004. Their report indicates that operational testing has not even started and that test conditions are not close to being realistic. None of the X-band radars that are central to the system are built hence we are exposing ourselves and the world with a system that has no hope of working.

Even if the technology worked perfectly, the systems being deployed are vulnerable to countermeasures that are easier to build than the long-range missile on which they would be placed. The UCS-MIT report *Countermeasures* was instrumental in calling attention to this problem and contributed to President Clinton's 2000 decision not to deploy the system the Bush administration is now fielding.

Therefore, given the potential severe environmental damage from both testing and deployment of this program, a true no action policy is preferable.

Beyond the lack of proven functionality there are other very important environmental reasons to choose a real no action item.

Whereas, there is no true threat of an intercontinental nuclear attack either on the basis of weak positions of our current allies such as China, Russia and that other states who are considering the development of nuclear weapons such as Iran and North Korea don't have the capability without detection;

Whereas, the implementation of NMDS will require us to withdraw in a more substantive way from the AntiBallistic Missile Treaty, which sends a message that the United States scoffs at international treaties that have up until now protected us and provides a very good and important mechanism for inspections;

We must conclude that the option for maintaining and improving on a prevention strategy based

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on international cooperation, inspection and enforcement of international treaties that are agreed to by all parties is the most effective option.

The impact environmentally and socially of the incredible amount of money to be spent has also not been addressed. The Pentagon's missile defense and space budgets together stand at over $23 billion, which does not include highly classified "black budget" spending this year alone. However, this year's allocations represent only a small portion of the Defense Department's anticipated investment on the system. In five years the Bush Administration estimates ballistic missile defenses will cost some $53 billion per annum. The full cost of deploying and maintaining BMDS is estimated to be between $800 billion and $1200 billion over the next 15 years. This represents an incredible amount of money will have been circumvented from true protection of public and environmental health.

In addition, our posturing to continue to build this non-functional system stimulates other countries to strive harder and faster to develop nuclear weapons to protect themselves from the United States whom they perceive as a rogue state, that violated international law by invading Iraq. When other nations devote a larger percentage of their national budget on military and defense then the environmental issues are neglected. These countries will then unleash untold amounts of pollution and plunder their natural resources that are wasted all for the sake of protection from the United States, not the least of which is their own nuclear and toxic environmental exposures to the world's citizenry including the U.S. since nuclear fallout has no boundaries.

Of course it can't be stated enough that this cycle also increases the chances of a nuclear accident.

The costs of this program for the United States while increasing pollution, keeps us from devoting adequate funds from the clean up of former nuclear sites where at Hanford alone still threaten groundwater and the Columbia River.

Direct Environmental Impacts

The BMDS has unacceptable environmental risks.

1) The result of release of hydrogen chloride, aluminum oxide, and hydrochloric acid into the upper atmosphere will consume huge amounts of ozone, resulting in dramatic increases in UV light exposure with epidemics of skin cancer, cataracts and the less studied but know effects on sensitive species such as amphibians and microscopic organisms.

2) Radioactive fallout from intercepted missiles has not been considered in this PEIS. The accepted concept that a missile blown up in the outer reaches of the atmosphere is a the logical conclusion of the BMDS alone should keep us from deploying such a system and rather focus on truly preventative strategies that do not accept any nuclear weapon use by any country.

3) Rocket launches result in incredible amounts of chemical releases. Liquid propellants containing hydrazines, nitrogen tetraoxide, and other compounds are highly toxic to all living species. Ammonium perchlorate used in solid propellants blocks the formation of key thyroid hormones which are critical for growth and development especially in fetuses and children. The PEIS proposes to allow over 30-fold higher levels of perchlorate (200 parts per billion) than that proposed by the State of California (6 parts per billion).

4) The risk of accidental missile launching to civilian or military aircraft is a real concern. The window of opportunity for successful launch is too narrow given its unproven track record, that the target identification is inadequate. This will result in incredible toxins being released as aircraft contain fuel,

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sometimes depleted uranium ballast, among other cargos not to mention the deaths of innocent victims.

5) The fuel needed for space based interceptors or satellites will most likely be nuclear. Solar energy appears too unreliable hence our conclusion that nuclear sources will be used. Nuclear exposure will likely occur then given a 15% failure rate of launch, as evidenced by the recent satellite crash in southern United States with little and inadequate information on the nuclear waste exposure.

6) Space debris from high altitude, mid-course missile intercepts or destruction of satellites will also result and contribute to significant interference to peaceful satellite missions and rain down toxic debris.

Thank you for the opportunity to comment on this very important issue. I would like a receipt of my comments.

Sincerely,

Catherine Thomasson, MD

DC_E0423

Johnson, Kathryn

From: Lauren Ayers
Sent: Thursday, November 18, 2004 1:08 AM
To: mda.bmds.peis
Subject: Amended statement

To Whom It May Concern,

I've been alerted to the problems of BMDS and am submitting these comments on the PEIS.

My major concerns have no place in the narrow confines of the comment process but I add them at the end anyway because the unintended consequences of many seemingly benign endeavors have come back to haunt humanity.

To directly address the impacts of BMDS, I have these comments:

1. It is too expensive for what we get. The opportunity cost of that money going to BMDS could bankrupt us the way the USSR exhausted itself with its military budget. We would be better off with a more educated population who have decent jobs, and a cleaner environment, which we won't be able to afford.

2. The hydrogen chloride injected into the atmosphere with each launch has incredible potential to neutralize ozone, enlarging the famous hole which now requires Australian school children to be outside only with hats and long-sleeved shirts.

Now for the larger picture. The BMDS PEIS does not include a real "No Action Alternative" of not developing ballistic missile defenses, Like a number of medical treatments, from bleeding people hundreds of years ago to Viox a month ago, the remedy is worse than doing nothing.

As a teenager, I was proud that my father worked for the Arms Control & Disarmament Agency. Besides the huge tax savings that resulted from the test ban treaties, we have no idea of what sort of nuclear catastrophe we avoided.

Much later, when President Reagan brought up his Star Wars notion, the feasibility reports made it clear what a ridiculous idea this was, like trying to stop a bullet with a bullet. Nevertheless, by preying on Americans' fears, Star Wars was moving ahead. Luckily, the collapse of the Soviet Union ended the foolishness.

By building Star Wars, we set a terrible example to other nations that we intend to be invulnerable, and therefore we become a threat to all other nations. They have no reason to trust us not to initiate war.

We now live in a world of terrorist threat. We need to learn that resentment of imperious America fuels more violence than we can ever head off, and that threats to our security will be as low tech as having religious fundamentalists give up their lives to pilot planes into office buildings. Fairness, respect, and cooperation are key in defusing

True, there are other nuclear nations that could launch against us. However, it would be far wiser to give every North Korean, Pakistani and Indian a share of what it would cost to build Star Wars so they can buy land, build houses, start businesses, and educate their children. Peace comes from contented people in prosperous nations.

Americans don't pay much attention to complex technological and scientific issues. But when they find out the monetary and social costs of following the wrong experts' advice, they get very angry.

Citizens rose up to stop above ground atomic bomb testing and supported the test ban treaty. We insisted on the Clean Air and Clean Water Acts. We buy more organic food every year because that is safer to eat and better for the environment.

Why not do the right thing now, instead of trying to clean up the mess later? An ounce of prevention is worth a pound of cure.

Lauren Ayers

Johnson, Kathryn

From: Robert Gould
Sent: Thursday, November 18, 2004 1:20 AM
To: mda.bmds.peis
Subject: Comments on Proposed BMDS PEIS

11-17 Gould-NMD Comments.doc (...

November 17, 2004

MDA BMDS PEIS
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

To whom it may concern:

I am submitting the following brief comments regarding the BMDS PEIS. In addition to being an Associate Pathologist at Kaiser Hospital in San Jose for more than 23 years, I am currently Immediate Past President of the national organization Physicians for Social Responsibility (PSR), which comprises approximately 30,000 members. Our organization is committed to the elimination of nuclear and other weapons of mass destruction, the achievement of a sustainable environment, and the reduction of violence and its causes. PSR is the U.S. affiliate of the International Physicians for the Prevention of Nuclear War (IPPNW), recipient of the 1985 Nobel Prize for Peace for its efforts to prevent nuclear war. I have been President of the SF-Bay Area Chapter of PSR since 1989, and I am writing this on behalf of our approximately 2,000 physician and allied health professional membership.

In considering the Environmental Impact of the proposed BMD system, the PEIS should address the full extent of possible environmental impacts on our planet and the proposed surrounding outer space intended field of operations. Concerns include not just potential direct environmental damage, but indirect effects. The latter include the potential for encouraging the continued global proliferation of nuclear weapons with associated environmental effects ranging from development, production, testing, deployment and use. They also include the fiscal impact of projected costs of the BMD system that could otherwise be used to redress the significant health and environmental problems that plague our planet, and that would likely increase with anticipated accelerated global climate change. These problems need major investments in capital that are being squandered on wasteful projects such as the BMD that inherently violate fundamental public and environmental health principles of primary prevention—-in this case concentrating on eliminating the source of the problem being "defended" against: the continued stockpiling and proliferation of nuclear weapons.

Specific comments follow:

1) The BMDS PEIS does not adequately address a number of potential environmental and health hazards that would be associated with various aspects of development and deployment. These include:

a) The planned heightened increase in missile launches would potentially lead to increased exposures to the population from toxic pollutants. These include liquid propellants containing hydrazines, nitrogen tetroxide, and other toxic compounds. In addition, the ammonium perchlorate used in solid propellants blocks the formation of key thyroid hormones which are critical for the growth and development especially in fetuses and children. The PEIS proposes to allow an over 30-fold higher level of perchlorate (200 parts per billion) than those proposed by the State of California (6 parts per billion). The numerous anticipated rocket launches will release chemicals including aluminum oxide,

hydrogen chloride and hydrochloric acid into the upper atmosphere, with the potential for further depleting the diminished ozone layer.

For example, each molecule of hydrogen chloride consumes 100,000 molecules of ozone, resulting in the widening of the ozone hole, thereby dramatically increasing levels of UV light. Elevated levels of UV light cause sunburn, skin cancer, cataracts, and many other forms of UV damage to sensitive species;

b) The potential risks posed by BMD missiles accidentally shooting down civilian and/or friendly military aircraft;

c) The potential impacts of space debris from high altitude, mid-course missile intercepts or destruction of satellites on global populations;

d) The potential environmental impacts of nuclear power sources that would likely be employed for deploying space-based satellites and interceptors;

e) The potential radioactive fallout from intercepted missiles.

2) The proposed BMDS is extremely economically wasteful at a time of constrained domestic budgets that are likely to persist far into the future, given the combination of massive military budgets and tax cuts. As indicated in the aforementioned general comments, the monies proposed for the BMDS could better be spent to redress a variety of compelling national and global health and environmental problems.
In 2004, the U.S. is spending approximately $450 billion on its military – and this does not include the past and present "supplemental" costs of the wars in Iraq and Afghanistan, which are already estimated at an excess of $200 billion. The DoD missile defense and space budgets of over $23 billion do not include highly classified "black budget" items. On top of this, in five years, the present U.S. Administration estimates that ballistic missile defenses will cost approximately $53 billion per year. The full cost of deploying and maintaining BMDS has been estimated to be between $800 billion and $1,00 billion over the next 15 years.

3) The BMDS is being proposed at a time when there are only two potential US adversaries (China and Russia) that have the capacity to deliver a long-range missile that can reach the United States. Currently, China maintains only 18 de-alerted missiles that can reach the US mainland. At present no other nations threaten to deploy attack weapons in space. We believe that US deployment of anti-missiles and space-based weapons will provoke increased hostility towards the U.S., heightening the chances of China and Russia and other nations responding with their own innovations and counter-measures. A good example of this was the announcement by Russian President Putin of a new nuclear missile system in line with previously disclosed plans to develop a new generation of sea- and land-based missiles capable of penetrating ballistic missile defense systems. ("Russia Is Said to Develop New Nuclear Missile," AP, New York Times, November 17, 2004) Hence, instead of affording Americans secure protection from missile attack, the proposed defenses may lead to a situation of greater danger. It is also well-known that the elaborate BMD systems being planned would be ineffective against low-tech attacks by terrorists who have already demonstrated the deadly use of box cutters and smuggled weapons, or who could possibly employ radiological weapons in the future.

4) The BMDS PEIS does not include a real "No Action Alternative". Such an alternative that does not include further development testing or deployment of BMDS weapon systems needs to be considered and included in the PEIS. Such a "No Action Alternative" would include strong support for efforts by the UN and nations around the world to enhance security through strengthening inspection and verification protocols of existing treaties, and by re-commitment to arms control and disarmament approaches that to date have served to limit global Weapons of Mass Destruction (WMD) proliferation. As such, the PEIS needs to consider explicitly whether the BMDS would itself encourage the proliferation of WMD, as well as an arms race in space, with examination of the likely response of other nations to the BMDS. As the BMDS is coupled to continued U.S. nuclear weapons programs, will this lead other nations horizontally proliferate for "deterrence" capabilities?

Please acknowledge that you have received these comments.

Respectfully submitted,

Robert M. Gould

DC_E0425

Johnson, Kathryn

From: Jonathan Parfrey
Sent: Thursday, November 18, 2004 2:36 AM
To: mda.bmds.peis
Subject: last minute additional comment

November 17, 2004
11:32 PM (PST)

MDA BMDS PEIS
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031
(sent via email)

Attention: Public Participation Officer

Dear Sir or Madam,

Please factor an inhalation pathway for exposure to ammonium perchlorate. Please asses for both public and occupational exposure. For toxicity information on this newly discovered pathway please see the following study.

1: Wei Sheng Yan Jiu. 2004 Mar;33(2):208-10. Related Articles, Links

[Study on the injury effect of ammonium perchlorate to lung]

[Article in Chinese]

Yang H, Peng K, Chu Q, Zhao S.

Public Health School, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, China.

OBJECTIVE: To study the injury effect of ammonium perchlorate (AP) to lung and to explore whether AP can cause pulmonary fibrosis. METHODS: To detect the levels of cell counts, TNF-alpha, MDA, HYP and the synthesis of collagen in BALF or rat lung after a certain time when rats were injected AP by intratracheal instillation. RESULTS: AP could bring about acute lung damage and inflammatory reaction. The levels of TNF-alpha of different groups in different time were obviously higher than the normal control group($P < 0.05$). AP could affect the levels of MDA, HYP and the synthesis of collagen. But it had no obviously pathological change of pulmonary fibrosis. CONCLUSION: There were acute injury effect about AP to lung, but this experiment could not make sure whether AP could cause pulmonary fibrosis.

PMID: 15209008 [PubMed - indexed for MEDLINE]

Thank you.

DC_E0425
Jonathan Parfrey

DC_E0427

Johnson, Kathryn

From: Jimmy Spearow
Sent: Thursday, November 18, 2004 8:11 AM
To: mda.bmds.peis
Subject: MDA PEIS Form Responses

Dear MDA I am not sure if the web site properly submited my BMDS PEIS comments so I am sending a duplicate copy of them again below . It was nice meeting you in Sacramento. Thank you very much.
Jimmy

Missile Defense Agency
BMDS PEIS
Comment Form

Name: Jimmy Spearow, Ph.D.
Ph, D. in Genetics,
With experience in Genetics, Physiology and Reproductive Toxicology
Member Physicians for Social Responsibility

Organization: United States Citizen

Address1:

Address2:

Comments:

November 17, 2004

Dear US Missile Defense Agency (MDA);

Please consider the following comments on the Draft Programmatic Environmental Impact Statement (PEIS) of the Ballistic Missile Defense System (BMDS).

1) Addressing Scoping Comments: I submitted a number of comments, on the scope of the BMDS several of which appear to have not been adequately addressed in the draft BMDS PEIS. These will be addressed in each specific comment. As discussed with Mda officials at the Sacramento public hearing, the MDA should provide more time for additional individuals from the most affected regions, including California and Alaska to comment on the BMDS PEIS.

2) Security, freedom, civil liberties, prosperity, the rule of law and the defense of the US constitution and its environment are very important to me as a citizen of this great country. Environmental sustainability is indelibly tied to our prosperity, and more abstractly to our security and freedom. We all want to be safe form missile attack. However, I am very concerned about the interconnected environmental, security and arms proliferation consequences of the US Missile Defense Agency (MDA) plans to establish a vast land, air, sea, and space- based Ballistic Missile Defense System (BMDS) including interceptor and laser weapon systems, sensors and command and control communication systems. The BMDS presents a number of toxic contamination and exposure risks as well as risks to

DC_E0427

health and safety that must be considered under the National Environmental Policy Act (NEPA). In so many cases the BMDS PEIS under estimates the magnitude or importance of these risks. These underestimates of environmental effects will be discussed under specific comments.

3) The BMDS PEIS does not include a real "No Action Alternative". Such an alternative that does not include further development testing or deployment of these weapon systems needs to be considered and included in the PEIS. The BMDS PEIS has not considered the "No action Alternative" of re-joining the UN and many nations of the world in working to enhance security through treaties and arms control and disarmament approaches, e.g. the approach that has provided us with long-term security to date.

4) The BMDS does not consider the direct, indirect and cumulative effects of the BMDS as required by NEPA, especially in regard the effects of the BMDS on the Arms race, which puts us closer to the disaster of nuclear war. In this regard, the PEIS is completely lacking a non-proliferation analysis. The BMDS tries to sell missile defenses to the public as a way to go beyond nuclear deterrence. Yet the BMDS is a dramatic escalation of a missile defenses that is not relevant for defending from terrorists who are much more likely to smuggle WMD. Securing loose nuclear materials is a much more effective strategy for preventing such terrorist nuclear threats.
The BMDS PEIS ignores the fact that the US posses extensive offensive nuclear and conventional weapon systems and that the proposed BMDS will operate along side these offensive weapon systems. The BMDS PEIS ignores the fact that the U.S. has a preemptive nuclear and conventional first-strike warfare policy and has exercised this policy in preemptively / preventatively invading other countries that have not attacked the U.S. including Iraq. Pronouncements of US preemptive offensive nuclear and conventional first strike policy as articulated in the 2002 Nuclear Posture Review; the 2002 Defense Guidance Policy; many statements of Bush, Cheney, Rumsfeld, and Wolfowitz, as well as the unprovoked 2003 invasion of Iraq, have together furthered international fears of the prospect of unprovoked unilateral attacks by the US. Building a massive land, sea, air and spaced-based BMDS is very likely to further invoke international fears that it will be used in conjunction with US offensive first strike and command and control communication systems to attack and/or dominate other countries.

The BMDS PEIS ignores the reasonable forseeability that it forces other nations to proliferate and/or smuggle WMD so that they can re-establish deterrence. Indeed, Russia and China have already started to proliferate and develop counter measures in response to the impending development of the U.S. BMDS (Evans 2004). Previously non-nuclear nations such as North Korea have stated that they also proliferated in order to establish a deterrent. In short, many nations are concerned that a US BMDS will eliminate their ability to deter attack, and assure the ability of U.S. forces to intervene anywhere in the world with offensive weapons systems. Such fear and insecurity has a reasonable forseeability of driving WMD proliferation and thereby decreasing rather than increase our security for years to come. Such WMD proliferation and the treat of nuclear war will have major environmental consequences. Thus, the BMDS needs a non-proliferation analysis which considers the direct, indirect and cumulative effects of the BMDS as well as other entities.

In essence, the combined direct, indirect and cumulative effects of the proposed BMDS in conjunction with US offensive weapon systems and US preemptive first strike military policy is very likely to invoke fear of US actions and intentions. Furthermore, a BMDS would be much more likely to be effective in intercepting ICBMs of another nation, if the BMDS were to be used following a preemptive nuclear first strike. Since the nation that strikes second loses for sure, the BMDS destabilizes the policy of nuclear deterrence that has helped to keep the peace for over 50 years. There is more than a reasonable foreseeability that the resulting paranoia will cause a major arms race, and send us into confrontations and wars of great scale. Such wars seriously threaten all we as a people hold dear; health, safety, and our environment.
The threat of the BMDS leading to a more aggressive nuclear policy and nuclear war can be seen in the

historic article "Victory is Possible" by Colin S. Gray and Keith Payne, Foreign Policy Summer 1980, pp. 14-27. These authors state: "If American nuclear power is to support U.S. foreign policy objectives, the United States must possess the ability to wage nuclear war rationallyŠ.
"ŠThe United States should plan to defeat the Soviet state and to do so at a cost that would not prohibit U.S. recoveryŠ.
Washington should identify war aims that in the last resort would contemplate the destruction of Soviet political authority and the emergence of a postwar world order compatible with Western valuesŠ.
Once the defeat of the Soviet state is established as a war aim, defense professionals should attempt to identify an optimum targeting plan for the accomplishment of that goal. For example, Soviet political control of its territory in Central Asia and in the Far East could be weakened by discriminate nuclear targeting. The same applies to Transcaucasia and Eastern EuropeŠ.
Strategists cannot offer painless conflicts or guarantee that their preferred posture and doctrine promise a greatly superior deterrence posture to current American schemes. But, they can claim that an intelligent U.S. offensive strategy, wedded to homeland defenses, should reduce U.S. casualties to approximately 20 million, which should render U.S. strategic threats more credible. Š
A combination of counterforce offensive targeting, civil defense, and ballistic missile and air defense should hold U.S. casualties down to a level compatible with national survival and recovery. The actual number would depend on several factors, some of which the United States could control (the level of U.S. homeland defenses); some of which it could influence (the weight and character of the Soviet attack); and some of which might evade anybody's ability to control or influence (for example, the weather). Š
No matter how grave the Soviet offense, a U.S. president cannot credibly threaten and should not launch a strategic nuclear strike if expected U.S. casualties are likely to involve 100 million or more American citizens." Š (**Victory is Possible** by Colin S. Gray and Keith Payne *Foreign Policy*, Summer 1980, pp. 14-27).
Note that these authors also helped to write the 2002 US Nuclear Posture review, which further solidifies the US preemptive nuclear first strike policy. Gray and Payne make it clear that BMD is essential for a more aggressive US nuclear first strike policy. Thus, there is a reasonable foreseeability that the BMDS in conjunction with US offensive nuclear forces will increase the probability of a massive nuclear war. Thus, the BMDS needs to include a detailed analysis of the environmental effects of "limited" and "all out" nuclear war, including: medical radiological, blast, burn, fallout, disease, and cancer effects to health and safety; effects on nuclear winter, as well as effects on atmosphere, global supplies of fresh water, global food supplies, and nuclear power plants and power systems. The prospect of the BMDS leading to more aggressive US policies that result in a massive nuclear war also needs to be considered in regard to a true no action alternative.
In short, since there is a reasonable forseeability that the BMDS in conjunction with US and Allied nuclear weapon systems and current US nuclear weapons policy as defined in the 2002 Nuclear policy review will destabilize the nuclear arms race and lead to nuclear war, the environmental consequences of nuclear war need to be considered I detail in the BMDS PEIS. (Ambio Volume XI number 2-3, 1982, Nuclear War: The Aftermath. Entire journal dedicated to the effects of nuclear war, including effects on heath and safety, Air, water resources, agriculture, biological resources, and nuclear winter.)

This requested in my scoping comments was ignored. e.g. Scoping comment "#18) The MDA needs to consider whether the BMDS in conjunction with offensive first strike weapon systems and first strike policy increase the probably of a major nuclear war or other disturbance that could result in nuclear Winter, with the associated loss of species"

5) **The BMDS PEIS did not adequately consider impacts of Hazardous waste and materials and on Health and safety, Water Resources and Biological resources of environmental contamination from toxic and hazardous components of rocket fuels and explosives.**
The BMDS PEIS markedly under reports the emissions of representative interceptors. Exhibit 4-11

reports the emission of (90+58+52+22+17+6+6)=251 pounds for a representative interceptor. However, ground based interceptors are much larger (approximately 54 feet long 3 stage solid propellant rockets (such as the Minuteman III) weighting 22.5 to 25 tons and containing approximately 30,000 to 45,000 pounds of solid propellant. Thus the MDA underestimates the emissions from such interceptor rockets by factor of greater than 100. This is totally unacceptable. This underestimate of BMDS pollutants is apparently repeated in Exhibits 4-13, 4-14 and 4-15. Thus the MDA needs to revaluate the environmental effects of these pollutants. Also the MDA should define what are the emissions from the missiles used to launch spaced based interceptors, and sensors.

6) Not only does the BMDS PEIS under represent the total amount of emissions, from the estimated 515 BMDS rocket launches over the next several years, it also discounts that this program will be injecting large quantities of chemicals including aluminum oxide, hydrogen chloride and hydrochloric acid into the upper atmosphere, stratosphere, etc. Most concerning is the injection of hydrogen chloride into the upper atmosphere where the breakdown of each hydrogen chloride molecule to chloride ion catalyzed the breakdown of 100,000 ozone molecules, thereby depleting ozone, and decreasing the blocking of UV rays. This depletion of ozone will increase risk of cataracts and skin cancer. Thus, the BMDS will have a much greater effect on ozone depletion and skin cancer than HCl released at sea level.

7) Liquid propellants containing hydrazines, nitrogen tetroxide, and other compounds are highly toxic. At very low concentrations, hydrazines irreversibly cross link to aldehyde groups on proteins at slightly acidic pH and can cause cancer. One of the most concerning pollutants from the firing of rocket engines is HCl, which combines with atmospheric water to produce acid rain. The PEIS did not address potential for interactions between HCl and hydrazines commonly used in rocket engines such as monomethylhydrazine (MMH) and Unsymmetric dimethylhydrazine (UDMH). Specifically does the toxicity of hydrazine increase under acidic conditions found in acidic rocket exhaust?

8) Ammonium perchlorate is one of the main components of rocket fuel, typically constituting 60% to 75% of missile propellant and about 70% of space shuttle rocket motors. Since the fuel and perchlorate goes flat, the fuel/perchlorate has to be replaced every few years or it will fail to function properly, thereby increasing the amount of perchlorate waste and exposure problems.
Ammonium Perchlorate is well characterized as a thyroid hormone disruptor.
http://www.ewg.org/reports/rocketscience/chap3.html . **At high enough concentrations, perchlorate can affect thyroid gland functions, where it blocks iodide uptake necessary for the synthesis of thyroid hormones (Urbansky 2002). Perchlorate can cause hypothyroidism, and thyroid cancer.** The environmental levels of perchlorate have been show to inhibit development in frogs (Goleman et al. 2002). California has extensive perchlorate contamination problems with the drinking water sources of at least 7 million Californians and millions of other Americans are contaminated with perchlorate. A federal **safe daily perchlorate exposure has not yet been set by the EPA, and its expected release in 2002 has been delayed. It has been delayed since the DoD objected to EPA studies suggested a standard of 1 ppb.** Senator Barbara Boxer has introduced legislation to require the EPA to establish a standard for perchlorate contamination by July 1, 2004. While most contaminated samples are in the 4 to 20 ppb levels, surveys of California water sources show several sites with perchlorate levels from 4 to 820 ppb.
http://www.ewg.org/reports/rocketwater/table1.php
Ammonium perchlorate used in solid propellants blocks the formation of key thyroid hormones which are critical for growth and development especially in fetuses and children. The PEIS proposes to allow over 30-fold higher levels of perchlorate (200 parts per billion) than that proposed by the State of California (6 parts per billion). As pointed out in the comments of Lenny Siegel: The reason that there is no federal drinking water standard for perchlorate is that the Defense Department objected to EPA studies that suggested a standard of one part per billion (ppb). Meanwhile, regulatory agencies are using levels far below the 200 ppb asserted in the PEIS. On the way to establishing its own legal standard,

California has adopted a Public Health Goal of 6 ppb (Frequently Asked Questions (FAQs) About the Public Health Goal for Perchlorate," California Office of Environmental Health Hazard Assessment (OEHHA), March 11, 2004. http://www.oehha.ca.gov/public_info/facts/perchloratefacts.html). Even these levels of perchlorate may be detrimental to fetuses and infants. The human study considered in setting the California public health goal did not evaluate pregnant women, fetuses or infants (Greer et al. 2002). The study of Greer et al 2002, only used a 14-day exposure to perchlorate, which is insufficient to deplete thyroid colloid which acts as a storage form of thyroid hormones. Thus this study is insufficient to estimate the effect of long-term perchlorate exposure on iodine uptake or thyroid hormone levels. Since the effect of long term perchlorate exposure on reducing thyroid hormone levels, especially in the fetus and in infants has not been considered, the MDA needs to evaluate these effects on these sensitive groups as required by federal law. In May, 2004, Massachusetts identified a reference dose for perchlorate that would correspond to a 1 ppb drinking water exposure limit. Also note that perchlorate is found in milk and in several plant species, including lettuce, where high levels have been reported. Thus multiple sources of perchlorate exposure need to be considered.

9) To ensure maximum environmental protection and reduce known, widespread human health risks from the use and disposal of rocket propellants, the BMDS PEIS should compare the proposed alternatives against a real No Action Alternative. At a minimum the BMDS PEIS should:
A. Acknowledge and address emerging regulatory standards for perchlorate exposure.
B. Consider the effects of perchlorate on susceptible subpopulations, including fetuses, and children. The MDA also needs to consider the effects of perchlorate exposure on even more sensitive congenitally hypothyroid populations, so that these individuals are not detrimentally affected by perchlorate from BMDS missile launches.
C. Since water supplies in several regions of central and southern California are already at, exceeding and in some cases markedly exceeding the emerging regulatory standards for perchlorate, the MDA should acknowledge and address the perchlorate problem so as to protect the public.

10**) The BMDS PEIS did not address my scoping comments that the** PEIS should address whether the BMDS testing endangers Health and Safety by missing its target or targeting the incorrect vehicle. The BMDS as described on the MDA web site is a risk to public safety as shown by the Patriot 3 (PAC-3) shooting down US and Allied British military planes during the 2003 US / British invasion of Iraq. According to a report in USA Today April 15, 2003, titled "Patriot Missile: Friend Or Foe To Allied Troops?" By Andrea Stone, It is seems that the Patriot has difficulty determining "friend from foe". In the first incident, on March 22, a Patriot missile downed a British Tornado GR4 fighter-bomber near the Iraq-Kuwait border, killing the two-man British crew. A U.S. F-16 fighter jet had to fire on a Patriot missile radar in Iraqi after the radar "locked on" to the jet. A Patriot-3 battery was also suspected in the downing of a U.S. Navy F/A-18 Hornet near Karbala on April 2, killing the pilot. Since several other Patriot friendly fire malfunctions are known, the MDA needs to consider how many civilians will be killed by the patriot BMDS.
Furthermore, the Aegis Cruiser system is a threat to commercial aircraft, as shown by the USS Vincennes mistakenly shooting down the Iranian Airbus commercial airliner flight 655 on July 3, 1988, killing all 290 civilians aboard http://www.geocities.com/CapitolHill/5260/vince.html . Over 100 witnesses reported seeing an upward arching flash of light immediately before TWA flight 800 exploded off of New York. However, government investigators refused to consider whether a missile launched from an unannounced ongoing naval exercise could have been the cause of the crash. The point is that the activation of BMDS risks accidentally shooting down civilian airliners, which was not even considered in the BMDS. While the BMDS states that warning will be provided to enable time to clear the airspace, it is highly doubtful that such time would be allowed in a perceived emergency. The BMDS PEIS needs to address these threats.

Both the PAC-3 and Aegis Cruisers are included as components of the proposed BMDS Since the PAC-

3 is a relatively short range system and is not designed for intercepting ICBMs, how many PAC-3 batteries will have to be deployed to offer full protection for the American and allied cities and military bases. Are these within range of any civilian aircraft? How will they discriminate attacking aircraft from commercial and civilian aircraft? The MDA needs to consider how many civilians and US/allied military personnel will be accidentally killed by the BMDS.

11) The PEIS provides conflicting information on the effects of the ABL on health and safety. The PEIS does not quantitatively assess the risk of the Airborne Weapons Laser (in a Boeing 747) blinding pilots and/or other civilians, stating mainly that humans and others would be exposed to the laser beam, mainly as reflected light for less than 0.01 seconds. However the PEIS provides no data on the wattage or power of these lasers in the PEIS making it impossible to assess the dangers of such laser exposure, especially to the eyes.
On Oct. 30, 1995, a Southwest Airlines' pilot in control of a flight departing McCarran International Airport in Las Vegas was temporarily blinded by a laser light. According to news reports, the incident was serious enough to force the plane's captain to take control until the pilot regained his sight. "Had it hit me and the other pilot simultaneously, I shudder to think what would have happened," the pilot told reporters. (http://www.fda.gov/fdac/departs/496_irs.html). Had the pilot been exposed to a high energy laser (HEL) as used in the BMDS the results could be much more debilitating, endangering the health and safety of numerous passengers.

The BMDS PEIS (page 4-32) cites that exposure to a reflected laser beam while in the air operating environment would be very short, < 0.01 seconds that and would not impact the health and safety (US Air Force 1997A). But no estimates are provided for the actual danger zone for the HEL to detrimentally affect health and safety, e.g. causing skin and especially retinal damage. The Draft Supplemental Environmental Impact Statement for the Airborne Laser Program (2002) (page 99) cites the power of the HEL as about 107 watts per square centimeter. Ten million watts per square centimeter will burn retinas and eyeballs very quickly. While the PEIS states that medium energy lasers such as the SHEL if focused at point 12 km away, would be hazardous to the human eye 2 km before to 2 km past the focus point. Where as the other lasers and especially the HEL would be hazardous immediately after leaving the turret of the ABL. While the PEIS states that the BILL and TILL no hazard distance would extend > 10 km beyond the target, and the HEL hazard distance would extend even beyond these distances. But the BILL, TILL and I presume the HEL hazard distances are apparently classified. How can the public comment on the effects of the BILL TILL and especially the HEL on health and safety if the of distance at which these lasers cause eye damage is not available? The public and the MDA / Air force need to make this information available to better ensure the heath and safety of the public.

The PEIS focuses on the testing of these lasers, but fails to reveal whether once deployed, the ABL or any other BMDS weapons lasers will ever be directed toward aircraft including airliners, or individuals on the surface of the earth, e.g. on land or at sea. If so, the MDA needs to address the effects of HEL and other weapons lasers on endangering health and safety, especially skin and eye damage.

12) The MDA PEIS needs to consider whether boost phase BMDS interceptors could be launched erroneously, causing another country to believe it was under attack, and thereby triggering a nuclear war. The American Physical Society examined the issue of boost phase intercept, and determined that the interceptor has to be very close to the ICBM, be launched within about 15-60 seconds from the time the ICBM was launched, and have much greater accelerations than the ICBM http://www.physicstoday.org/vol-57/iss-1/p30.html (Kleppner et al. 2004). The problem of boost Phase intercept is greater for solid rockets with high accelerations than for slower accelerating liquid rockets. The further problem is that ship based interceptors are not big enough and do not have sufficient accelerations to make a boost phase intercept even from a small country like North Korea and if it did intercept it is likely the warhead would not be destroyed by a kinetic hit-to-kill interceptor and would

continue on to near its intended destination. Finally, they point out that a boost phase launch intercept of a ICBM from North Korea would likely occur over northern China, further risking causing China to think it was under attack by the US which could cause a nuclear war (Kleppner et al. 2004). The BMDS needs to consider the realities of the limitations of any BMDS relative to a real no-action alternative of working toward disarmament through arms control treaties.

13) Space debris from high altitude, mid-course missile intercepts or destruction of satellites. The PEIS does mention that even tiny particles of space debris traveling at extremely high speeds in orbit can destroy space suits, rockets and satellites. While the PEIS correctly points out that debris from low orbital intercepts will decelerate once it hits the atmosphere, and thereby de-orbit. However the PEIS fails to consider the space debris from high altitude intercepts which risk producing space debris that could make space unusable for many years. While the PEIS considers testing the BMDS on "targets of opportunity", no mention is made of space debris resulting if other nations target US BMDS satellites or components in high orbit as "targets of opportunity". This must be considered since the resulting space debris could destroy objects in space, making space unusable as well as violating the 1967 space treaty.

14) The environmental consequences of many rocket launches needed to deploy and maintain space-based interceptors has not been adequately considered, nor has the environmental consequences of their fuel. Will space-based satellites/interceptors use nuclear power sources? Will any BMDS interceptors ever use nuclear warheads? While nuclear tipped-interceptors are not mentioned in the PEIS, per se. In Section 2.2.1.1 the PEIS does mention the possibly of destroying a missile by using interceptors with directed blast fragmentation kill vehicles. However the PEIS, fails to reveal the nature of the blast fragmentation device, which is needed for evaluation of its environmental effects. Instead the MDA PEIS states that "the interceptors will be discussed and analyzed for environmental impacts at the booster and kill vehicle level. This will allow the MDA the flexibility to configure new interceptors based on boosters and kill vehicles analyzed in this document to address new or emerging threats." This does not allow a satisfactory evaluation of the hazards of the BMDS components. What blast fragmentation devices will be used? The PEIS needs to include the details of chemical and toxicant use and exposure.

15) Radioactive and/or biological weapons fallout from intercepted missiles has not been considered in the PEIS. If a kinetic hit to kill interceptor knocks out an ICBM in the mid phase or terminal phase, the nuclear warhead or its fragments are going to produce a tremendous amount of radioactive contamination where ever they land. Such radioactive fallout will clearly have major, highly deleterious effects on adults, children, and especially on developing embryos, and fetuses. While such an interception is very likely to be highly preferable to damage resulting from an air or ground burst over a city, the resulting radioactive contamination needs to be considered. The effects of war are normally excluded from analysis by the National Environmental Policy Act (NEPA). However, the proposed BMDS action is very likely to provoke a worldwide WMD arms race, and force other nations to prepare to launch a massive retaliation against the US should war ensue. Thus, these effects need to be considered relative to a real no action alternative. Since the proposed BMDS is very likely to cause a massive arms race, the environmental consequences of a resulting War involving nuclear or other WMD should not be ignored. The PEIS needs to consider the environmental effects of fallout from intercepted WMD as well as the effects of WMD the BMDS fails to intercept. Thus PIES needs to consider these hazardous waste and materials issues. Appropriate references include "The Effects of Nuclear Weapons, Compiled and Edited by Samuel Glasstone and Philip Dolan, third Ed. DOD, DOE. 1977.

The American Physical society also identified the issue that boost phase intercept has a high probability of munitions carryover. A successful boost phase intercept is unlikely to disable ICBM's warheads or munitions. They will be deflected only slightly, if at all, and will continue on ballistic trajectories (Kleppner et al. 2004).

16) Will any interceptors use nuclear warheads? The PEIS does not address the inability of mid-course or terminal kinetic interceptors to stop a "threat cloud" once a attack missile has MIRVed, or released many decoys or countermeasures (Richard L. Garwin. Holes in the Missile Shield. Scientific American, November 2004, page 70-79). The MDA may be temped to intercept such a threat by using large nuclear tipped interceptors. The potential use of nuclear tipped interceptors was discussed by high ranking US DOD officials in 2002 http://www.washingtonpost.com/ac2/wp-dyn/A28866-2002Apr10?language=printer. If such nuclear tipped interceptors were deployed, the environmental risks would be much greater. If so, the environmental consequences of the nuclear fallout and electromagnetic pulses from such high altitude nuclear detonations must be considered in detail. This would include analysis of risks to health and safety, contamination of water, land, soils, EMP effects on civilian and medical electrical and computer systems and infrastructure. The MDA should also consider the effects of radioactive fallout on health and safety, biological resources, and contamination of land and water resources.
Furthermore, given the historic 15% missile launch failure rate, the radioactive fallout from accidents with nuclear tipped interceptors must be considered in detail. The public should have full opportunity to consider and comment on the use of such nuclear tipped interceptors in this PEIS. The point is that the blast fragmentation devices need to be described in detail to enable adequate evaluation of its environmental effects.

17) Also note that the technology and environmental effects of "advanced systems" remain to be defined. How can the environment effects of an undefined "advanced system" be evaluated in this PEIS? A full environmental analysis is needed for each component of the PEIS to be added. If any component of the BMDS will ever use nuclear warheads in any interceptors the MDA needs to thoroughly consider the environmental effects, as discussed above.

18) Will any MDA interceptors or Lasers use anti-matter weapons? A US Air Force anti-mater weapons research programs has recently been described in the SF Chronicle http://sfgate.com/cgi-bin/article.cgi?file=/c/a/2004/10/04/MNGM393GPK1.DTL. IF the BMDS will use antimatter weapons or energy sources, the environmental effects including the health and safety risks, and chemical exposure risks need to be described in detail.

19) **The BMDS PEIS needs to consider direct, indirect and cumulative effects of the proposed project in conjunction with other federal offensive military weapons systems and policies were not addressed**, but need to be addressed. The National Environmental Policy Act (NEPA) (http://ceq.eh.doe.gov/nepa/regs/nepa/nepaeqia.htm) and especially **The Regulations for Implementing NEPA** (http://ceq.eh.doe.gov/nepa/regs/ceq/toc_ceq.htm), state that both the direct and indirect effects of the proposed project as well as the Cumulative impact of the project should be considered. Sec. 1508.7 States that the "Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
In the context of this global ballistic missile defense system, the cumulative impact of reasonably foreseeable future actions of the US as well as other nations, agencies and persons need to be considered. Yet the reasonable foreseeable actions of other nations and individuals responding to the BMDS by proliferating WMD was not considered by the MDA in this PEIS.
As stated in Sec. 1508.8 "Effects" include:(a) Direct effects, which are caused by the action and occur at the same time and place and (b) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Effects and impacts as used in these regulations are synonymous. Effects includes ecological (such as the effects on natural resources and on

the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.
Thus, by law the MDA also needs to consider the Direct, Indirect and Cumulative impacts on the environment of the proposed BMDS along with other US offensive weapons systems and stated & demonstrated US preemptive first-strike policy.

The following points are points that need to be considered in the no action alternative.
20) The PEIS needs to consider whether the BMDS will result in Proliferation of Weapons of Mass Destruction (WMD) and an arms race in space. The response of other nations to the BMDS has not been considered. Specifically, the BMDS is coupled to other offensive weapons programs and will force other nations to proliferate and/or smuggle WMD so that they can re-establish deterrence. Relatively inexpensive countermeasures to BMD will likely thwart the goals of BMD. Such proliferation coupled with increased international tension will decrease rather than increase our security and lock us in to an expensive and destabilizing arms race and will have devastating long-term environmental consequences.

21) Alternative 3: Not developing, or building the BMDS or any of its components and instead renegotating an expanded and verifiable ABM / BMDS treaty: The ABM treaty helped to stabilize and de-escalate the nuclear arms race for all of its 29 years of existence. No country dared attack the US with nuclear missiles, in part because the U.S. would know exactly where the missile came from and have the clear ability to retaliate and bomb them into obivilion. That is certainly still the case. This option would preserve deterrence and peace. Yet it would enable the nuclear nations to abide by the NPT and reduce the overall level of nuclear weapons, in exchange for non-nuclear nations not developing nuclear weapons.

22) Alternative 4: Preserving Space for non-military purposes. The MDA should consider the alternative of not militarizing space. The planned US militarization and domination of space as described in the US Space Command Vision for 2020 (http://www.fas.org/spp/military/docops/usspac/lrp/ch02.htm) and as described in the 2002 US defense guidance policy and elsewhere, will certainly create and intensify conflicts over the control of space for years to come. These US policy documents talk about "Full Spectrum Domination", "negating" or "destroying" the enemy's satellites and use of space. As US citizens we would like for the US to protect space from militarization, but do we want the US to dominate space, and to start a series of space wars? Think about how you would feel if you lived in another nation and some one destroyed your satellites. Would such actions be considered an act of war?
Additionally how does the BMDS PEIS affect US compliance with the Outer Space Treaty?

23) Alternative 5: Deployment of a much more limited land and or Sea based theatre BMD that would offer protection from attack by short or intermediate range missiles. For example, rather than develop the extensive land, Sea, air and space based system, the US and its allies could instead deploy a currently available Aegis missile cruiser(s) off of North Korea. Such a small, affordable, alternative system would immediately meet the needs of defending Japan against missiles that might be launched by North Korea without invoking fears that it would be used to enable invasions and/or domination of the world and thereby starting a massive global arms race.

24) NONPROLIFERATION ANALYSIS COMMENT
Based on my expertise in the area of genetics, physiology, toxicology and nuclear weapons control/non-proliferation, it is a **reasonable foreseeability** and in my opinion a very high probability that the proposed BMDS creates a significant risk of nuclear and biological weapons proliferation. This

proliferation risk goes hand in hand with a greater security risk, and both increase the potential harm to the environment and the public.

As pointed out by Nicole C. Evans, National missile defenses may undermine strategic stability by threatening the ability of other countries to retaliate, which is the core of their deterrence. Theater missile defenses do not pose this danger (Evans 2004). Evans goes on to describe Russian and Chinese concerns to National Missile Defense (NMD) and especially Global Missile Defense (GMD) as described in the BMDS PEIS. She also describes how Russia and China have already started to proliferate in response to the US renigging on the ABM treaty and preparing to deploy GMD, e.g. the BMDS.

Evans points out that; "Russia and China share two key concerns about American missile defense plans: that their nuclear deterrent is threatened and that American missile defense plans will destabilize arms control. Š
Both Russia and China have responded actively to the American abandonment of the ABM Treaty by developing asymmetrical measures to neutralize any potential threat. By withdrawing from START II, Russia was able to continue deploying multiple independently targetable reentry vehicles (MIRVs) on intercontinental ballistic missiles (ICBMs). Putin announced in October 2003 that Moscow intends to place on combat duty dozens of MIRVed SS-19s, and Russia has also extended the service life of its SS-18 heavy ICBMs. Russia has begun building the fourth-generation *Borey* class of submarines, is MIRVing its silo-based Topol-M, and is finishing testing the mobile version of the Topol-M." In February 2004 Russia also "successfully tested a new hypersonic "Crazy Ivan" warhead that follows a nonclassical scenario, changing flight altitude and course repeatedly, making it nearly impossible to track and target." Evans also points out that "Russia has also upgraded the A-135 strategic single-site ABM system covering Moscow, the only such system currently in operation. In 2002, Russia began working in earnest on TMD and is currently developing several advanced missile interceptors (Evans 2004).

Evans points out that "Both Russia and China appear unconvinced by American assurances that global missile defense is not directed against them, despite echoing American rhetoric about the need to defend against the terrorist threat. Senior Russian military and foreign affairs officials have argued that while the United States proclaims its partnership with Russia, its actions show anything but that. ŠRussian concerns are further aggravated by America's stated intention not to cut its nuclear arsenal to levels designated by the Moscow Treaty of May 2002--instead moving the missiles as well as the warheads into storage as a hedge against an uncertain future." (Evans 2004).

Evans then goes on to describe how China is responding to the US BMDS threat and "is moving toward a more diversified, invulnerable, and combat-ready operational nuclear triad." "Second, Russia and China are very concerned that American missile defense plans will destabilize existing arms control regimes and forestall future agreements."
Russia, China, and other states express deep concern about the weaponization of space. In 2003, Russia and China proposed an agreement for the non-weaponization of space, and negotiations continue at the Conference on Disarmament in Geneva. Both Moscow and Beijing maintain that nonproliferation measures and policing regimes are a better way of dealing with weapons of mass destruction than attempts to develop missile shields" (Evans 2004).
Evans Concludes "The real danger lies in the potential of GMD to disrupt delicate regional balances and to encourage the further development and deployment of nuclear weapons. The United States, China, and Russia have all stepped up their offensive weapons programs since the dissolution of the ABM Treaty. The danger has been succinctly summarized by Mohamed El Baradei, head of the International Atomic Energy Agency: "If we don't stop using double standards, we shall be piled high with an even greater number of nuclear weapons." That would create the exact opposite of the professed objective of

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global missile defense: security for all who want it" (Evans 2004). This article and several others by Arms Control experts show evidence that the BMDS is causing and will continue to cause WMD proliferation rather than preventing it. **Thus, a non-proliferation analysis is needed for the BMDS PEIS particularly in regard to a genuine no action alternative.**

The BMDS PEIS (page 2-68) provided a justification based on politics rather than on analysis of environmental policy as the rationale for not considering a real "No Action Alternative", namely the canceling of Ballistic Missile Defense Capabilities (and re-engaging in treaty - based arms reductions). On page 2-68 the PEIS states " As suggested to the MDA during the scoping process, one alternative would involve canceling the development of all ballistic missile defense capability development and testing. Such an alternative would rely on diplomacy and military measures to deter missile threats against the U.S. However, this proposed alternative would eliminate the capability to defend the U.S., it's deployed forces, allies or assets for a ballistic missile attack should diplomacy of other deterrents fail. This alternative does not meet the purpose of or need for the proposed action as described in Sections 1.3 and 1.4, respectively; does not meet the direction of the President and the U.S. congress; and therefore will not be analyzed further."

A mainly political justification was also given on BMDS PEIS pages 1-14 for not considering scoping comments showing "concern that the BMDS would create an arms race, especially in space" Š comments showing "opposition to the development of nuclear weapons and concern that missile defense could be a first strike capability for U.S. worldwide military domination". Specifically, the MDA PEIS stated the rationale for excluding these comments is that "Public comments concerning DoD policy, budget and program issues are outside the scope of the Draft BMDS PEIS".

These political justifications used by the MDA are insufficient for excluding these and related issues of non-proliferation from analysis in the BMDS PEIS. A non-proliferation analysis is needed for the BMDS. We all want to be safe from missile attack. The non-proliferation analysis is needed to determine if the BMDS is likely to ultimately increase our security, and maintaining environmental quality or result in an out of control arms race that decreases our security and wreaks wide spread environmental destruction.

Because of the reasonable foreseeability of increased potential for environmental harm due to proliferation and security risks, I strongly recommend that the MDA prepare a detailed Nonproliferation Impact Review for the BMDS PEIS including a Nonproliferation Impact Review EIS for each BMD component and for each BMD site or location. These reviews will determine the scope and need for a MDA high-level program and the alternative that would cause the least environmental harm. If the BMDS is the best alternative for such a program, these review processes will thoroughly assess the potential proliferation, security and environmental harms and ways to mitigate those potential harms. This will mean that proactive plans to protect the environment, public safety and national security will be developed in advance rather than in response to a problem, accident or crisis.

DOE Programmatic EIS Precedent

The DOE has set an important precedent by conducting a Programmatic EIS, including a Nonproliferation Impact Review (NIR), for its Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, including the Role of the Fast Flux Test Facility in December 2000 and for its Stockpile Stewardship and Management in September 1996. Furthermore, Nonproliferation Analyses were conducted in the following DOE EIS or Site-Wide EIS review documents:

· Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling (October 1995); Section 1.5.6 Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel, Page 1-10.

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· Final Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site(August 1998);

·Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor (March 1999).): 1.3.5
Nonproliferation, Page 1-9 and 1-10.

Final Site-Wide Environmental Impact Statement for the Y-12 National Security _ _Complex_ (September 2001): Section 2.2.3 Nonproliferation and National Security, Page 2-7.

Following this precedent, the MDA BMDS, in my opinion, necessitates an equally comprehensive review. Such a Nonproliferation Review Should Include Public Hearing, Scoping and Comment.

25) I highly recommend that the Nonproliferation Impact Review be conducted like the NEPA process that includes public participation in the scoping phase and a draft document circulated for public comment. This open process is critical because intent really is the biggest differentiating factor between defensive and offensive military research. The participation of individual citizens who live near the proposed facility and have personal concerns such as health and property values, as well as representatives from professional and nonprofit groups who specialize in public health, emergency response, sewage treatment, landfills, water, environment, toxicology, science, medicine and arms control may identify unforseen problems, more cost-effective solutions and new ways to open up the process while maintaining necessary security. This scrutiny and public debate can only improve the quality of the decision-making process and will likely result in more confidence in the final decision on the part of those most directly impacted.

26) Which government and university institutions in the State of California will be conducting research to support the BMDS research and development and, if so, please describe their roles, responsibilities and the specific projects they will be involved in? Specifically, will Lawrence Livermore National Laboratory, Lawrence Berkeley National Laboratory, Sandia National Laboratory -- Livermore, or the University of California at Berkeley, Davis or Los Angeles be conducting research or development on the BMD for the MDA or DoD and, if so, what specifically will each that is involved be doing? This is important for people in these areas to know in order to understand, consider and evaluate the possible environmental, health, and safety impacts on their communities.

Thank you for considering these public comments on the BMDS PEIS.

Please confirm that you have received my comments.

Jimmy L. Spearow, Ph.D.

"We must abandon the unworkable notion that it is morally reprehensible for some countries to pursue weapons of mass destruction yet morally acceptable for others to rely on them for security and indeed to continue to refine their capacities and postulate plans for their use." Mohammad ElBaradei, IAEA Director General (http://www.wagingpeace.org/articles/2004/03/26_road-prolilferation.htm)

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Ambio Volume XI number 2-3, 1982, Nuclear War: The Aftermath.

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Johnson, Kathryn

From: Marvin l Lewis
Sent: Thursday, November 18, 2004 9:37 AM
To: mda.bmds.peis
Subject: Subject: comments for PEIS on proposed Ballistic Missile Defense System

To the Missile Defense Agency (MDA):

The following comments on the environmental and political effects caused by the proposed Ballistic Missile Defense System (MDS) are submitted a day late. I respectfully request that the deadline for submittal of comments be extended for cause. The cause is that there was very little notice to the general public, and only those versed as to the ADAMS or government notice agencies or methods were privy to the proposed invitation to comment.

Comments:

Due to the lateness and my inabilities to absorb the entire contents of the notice in a timely manner I respectfully request that the following be accepted as my comments.

Major deficiencies:

The major deficiencies seem to be the lack of detrimental effects reported in the notice. There will be negative and detrimental effects.

One such effect is that Earth orbital space is gathering 'junk'. This 'junk' makes space incursions dangerous due to the possibility of crashes. Add to this the possibility that the new 'junk' from this program will be armed in various ways, and the detrimental effects suddenly become a major obstacle to the commercialization of space.

Another possible detrimental effect is that we are only now coming into new data on the effects of 'global warming gases' in the upper atmosphere. Some gases which acts as global warming gases at low altitude become global cooling gases at very high atmosphere. Water vapor is such as gas. The global heating effect of such gases in rocket exhaust is not well explored in the notice and deserves better exploration.

International Treaties:

There are several international treaties that affect this BMDS. Since I am not a lawyer, I shall limit my comment on this issue to the request that more concern be shown to the issue of international treaties before any action be taken.

Predicting the future:

Any proposal assumes predictions of the future. Some of these prediction are inadequate. The predictions should contain the experience of the present and the past. This notice does not look adequately at the presently available information.

At a minimum the notice should look at the rate of accumulation of information. What is proposed here does not adequately take into account what we know today.

1. The proposed BMDS can easily be as outmoded as the Maginot Line due to new technologies that are presently being developed. Nanotechnology is on the move. A nanotechnological technique loosed into outer space would easily affect a missile without any of the present technologies able to stop it.
2. EMP weapons are well developed. Hardening a BD against EMP would increase the weight to a point that the missile could not perform its function.
3. Commercials exploitation of space is in its infancy. Adding BMDS which would appear as a danger to tourists is not a great way to make space more commercially exploitable.
4. Other commenters have pointed out many negatives to this approach and I wish to join other commenters in their views of the negatives of BMDS outweighing any positives.
5. This BDMS has the potential to be so costly as to destroy the fiscal soundness of the United States.

Respectfully submitted,
Marvin Lewis

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Look for special offers at Best Buy stores.

DC_E0429

Johnson, Kathryn

From: Lenny Siegel [lsiegel@cpeo.org]
Sent: Thursday, November 18, 2004 11:39 AM
To: mda.bmds.peis
Cc: Jonathan Parfrey
Subject: My comments

Siegel-PEIS.doc
(197 KB)

On October 14, 2004, I orally presented commented on the BMDS PEIS, and I submitted a hard copy of my full comments. Here, for your convenience, is an electronic version of that expanded testimony.

Lenny Siegel
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Lenny Siegel

DC_E0429

CENTER FOR PUBLIC ENVIRONMENTAL OVERSIGHT
c/o PSC, 278-A Hope Street, Mountain View, CA 94041
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PERCHLORATE AND THE PROPOSED BALLISTIC MISSILE DEFENSE SYSTEM:
COMMENTS ON THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Lenny Siegel
October, 2004

Executive Summary

The Programmatic Environmental Impact Statement (PEIS) for the Ballistic Missile Defense System (BMDS) not only does an inadequate job of addressing the environmental impact of solid rocket propellant associated with this program, but it seems to ignore the purpose of the National Environmental Policy Act (NEPA). That is, rather than consider how to minimize negative environmental impacts in the design of a program, through "cradle to grave analysis," it uses the environmental document to justify decisions that have already been made.

Furthermore, the PEIS lacks a genuine "No Action Alternative," even though NEPA requires that such an alternative serve a baseline against which to compare the environmental impacts of the other alternatives. In particular, a No Action Alternative that posits little or no use of rocket propellant is essential if the program's proponents are to minimize releases of pollutants—particularly solid rocket propellant and its byproducts—into our nation's water supplies, air, or the upper atmosphere, either by selecting a program alternative or agreeing to binding mitigation measures.

Solid rocket propellant that contains ammonium perchlorate as an oxidizer is designed to generate large quantities of hydrogen chloride, which reacts with moisture in the atmosphere to create hydrochloric acid—that is, acid precipitation. The PEIS should consider how the missile defense program might develop and test alternate launch technologies that are not so environmentally destructive.

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When rockets are launched into the upper atmosphere, they directly deliver hydrogen chloride to the ozone layer, exposing human, other animals, and other biota to the harmful, persistent effects of ultraviolet-B radiation (UVB). Rocket launches are among the largest causes of ozone depletion, and the persistence of such substances from other sources is no excuse for additional pollution. The BMDS program should at the very least evaluate the mitigation of such seriously harmful environmental consequences through the development and deployment of alternative solid rocket propellants.

Perchlorate, primarily from the manufacturing, testing, aborted launches, maintenance, and decommissioning of solid rocket motors, is polluting the drinking water of more than twenty million people and may be endangering natural ecosystems from Cape Canaveral to the Marshall Islands. The PEIS understates the risks of exposure, and it fails to provide data on the quantities of solid rocket propellant likely to be produced, used, released, and disposed by the BMDS. The PEIS should consider the environmental consequences of various disposal strategies so the BMDS program can develop the technology or capacity to address its waste or consider the use of alternative launch technologies or strategies to minimize either the waste or the negative environmental impacts.

Conclusion

To ensure maximum environmental protection and reduce known, widespread human health risks from the use and disposal of solid rocket propellant, the Programmatic Environmental Impact Systems for the Ballistic Missile Defense System should compare the proposed alternatives against a genuine No Action Alternative. At a minimum it should::

1. **Provide more detailed estimates of perchlorate waste likely to be generated by system development, testing, deployment, maintenance, and decommissioning *and* acknowledge emerging regulatory standards for perchlorate exposure.**

2. **Consider in detail the management practices—launch protocols, treatment technologies, etc.—necessary to mitigate the significant environmental impacts, including increased depletion of the stratospheric ozone layer and the likely release of perchlorate into groundwater, surface water, and soil.**

3. **Evaluate alternative launch technologies not based upon ammonium perchlorate.**

Based upon such additional environment review, which I believe is mandated by any fair reading of the National Environmental Policy Act and its implementing regulations, Program Managers should use the information generated to help evaluate all alternatives and to mandate actions to minimize or mitigate the serious environmental consequences associated with such a large and continuing use of solid rocket propellant. Such steps are necessary to protect the American people, the ostensible purpose of the Ballistic Missile Defense System.

Introduction

I have been asked, by Physicians for Social Responsibility-Los Angeles, to review the draft Programmatic Environmental Impact Statement (PEIS) for the Ballistic Missile Defense System (BMDS), with a focus on the environmental impact of solid rocket propellant associated with this program. I find not only that the PEIS does an inadequate job of addressing these impacts, but like many other environmental reviews it seems to ignore the purpose of the National Environmental Policy Act (NEPA). That is, rather than consider how to minimize negative environmental impacts in the design of a program, through "cradle to grave analysis," it uses the environmental document to justify decisions that have already been made.

The PEIS lacks a genuine, "No Action Alternative," as required under NEPA. It rejects evaluation of the alternative, "Cancel Development of Ballistic Missile Defense Capabilities," because it "does not meet the purpose of or need for the proposed action ..." (page 2-68). This approach misunderstands how NEPA works. It is acceptable to evaluate and reject a No Action Alternative because it doesn't meet the purpose of a program, but the environmental impacts of that alternative must be considered as a baseline against which to compare the environmental impacts of the other alternatives.

In particular, a No Action Alternative that posits little or no use of rocket propellant is essential if the program's proponents are to minimize releases of pollutants into our nation's water supplies, air, or the upper atmosphere, either by selecting a program alternative or agreeing to binding mitigation measures.

The bulk of my analysis focuses on the manufacture, use, and disposal of solid rocket propellant containing ammonium perchlorate, because that is the propellant to be most widely used by the Ballistic Missile Defense program. However, liquid propellants, such as the hypergolic propellant containing hydrazine compounds and nitrogen tetroxide, are highly toxic, and the PEIS should consider how to minimize their environmental, health, and safety impacts as well.

At least by number, the 515 projected BMDS launches over the decade beginning this year dwarfs the 99 other projected government launches and the 77 estimated U.S. commercial launched anticipated over the same time period. The environmental review of such a large system, to be developed over a period of many years and potentially deployed for decades, provides an opportunity to reconsider the technologies that our country uses for launching rockets. The draft Programmatic Environmental Impact Statement ignores that opportunity.

Air Emissions

Solid rocket propellant that contains ammonium perchlorate as an oxidizer is designed to generate large quantities of hydrogen chloride. That is, hydrogen chloride is not generated as a product of incomplete combustion of when a system leaks. Rather, it is released as the normal combustion product of the reaction of aluminum and ammonium perchlorate. Then, hydrogen chloride reacts with moisture in the atmosphere to create hydrochloric acid—that is, acid precipitation. The PEIS briefly recognizes this:

> In biomes where rain is a frequent occurrence, launches with solid boosters have an increased likelihood of contributing to acid rain, thereby increasing the amount of HCl deposited in regional surface waters. In areas with low velocity of surface and groundwater movement and relatively shallow ground water table it is possible that deposition of acidic water may impact water resources. The potential for and extent of impact would need to be examined in site-specific environmental analysis. (page 4-60)

Waiting for site-specific analysis in the indefinite future condemns project sites to acid precipitation. There is no hint of how such an environmental impact might be mitigated. The proper analysis, at this stage, is to consider how the missile defense program might develop and test alternate launch technologies that are not so environmentally destructive. That is, the best solution is not likely be site-specific, so the PEIS itself should evaluate this impact.

The PEIS suggests that aluminum oxide, the other major combustion product of solid propellant, is non-toxic. (page 4-60) However, there is some evidence that aluminum in acid environments is toxic to fish.[1] The PEIS should review the literature and reconsider its conclusion based upon the weight of evidence.

Ozone Depletion

Furthermore, when rockets are launched into the upper atmosphere, they directly deliver hydrogen chloride to the ozone layer that protects the Earth against the harmful, persistent effects of ultraviolet-B radiation (UVB). The hydrogen chloride breaks down, releasing chloride ions that trigger catalytic reactions in which one chlorine atom can destroy over 100,000 ozone molecules. I call the delivery of chloride, in the form of rocket exhaust, to the upper atmosphere: "Free-basing the ozone layer."

Increased exposure to ultraviolet radiation causes universal damage to both human health and the natural environment. "… UVB causes nonmelanoma skin cancer and plays a major role in malignant melanoma development. In addition, UVB has been linked to cataracts.… Physiological and developmental processes of plants are affected by UVB radiation…. Scientists have demonstrated a direct reduction in phytoplankton production due to ozone depletion-related increases in UVB.… Solar UVB radiation has been found to cause damage to early developmental stages of fish, shrimp, crab, amphibians and other animals.…"[2]

Once again, the PEIS acknowledges this environmental impact, but it plays it down: "The cumulative impact on stratospheric ozone depletion from launches would be far below and indistinguishable from the effects caused by other natural and man-made causes." (page 4-114). I

[1]See, for example, Baker & Schofield, "Aluminum Toxicity to Fish in Acidic Waters," *Water, Air, and Soil Pollution,* 1987, cited in Heinz J. Mueller, Chief, Environmental Policy Section, Federal Activities Branch, U.S. EPA Region 4, "Environmental Assessment (EA) and Finding for No Significant Impact (FONSI) for the Proposed Titan IV Upgrade Program. Cape Canaveral Air Force Station (CCAFS) and Kennedy Space Center (KSC), FL," letter to Captain Anthony E. Fontana, III, Environmental Planning Division, Regional Civil Engineer, Eastern Region, Department of the Air Force, March 28, 1990.

[2]"The Effects of Ozone Depletion: The Connection Between Ozone Depletion and UVB Radiation," U.S. EPA, June 21, 2004. http://www.epa.gov/ozone/science/effects.html

appreciate the data presented in Appendix I, but the conclusion reached by the authors is implausible.

The PEIS estimates that proposed BMDS launches from 2004 through 2014 would release approximately 1,350,000 kilograms (3,000,000 pounds) of chlorine, primarily in the form of hydrogen chloride, in the stratosphere. Annually, that would be 135,000 kilograms (300,000 pounds). In comparison, official U.S. EPA data estimates annual (2001) U.S. emissions of most destructive industrial ozone-depleting chemicals to total about 50,000,000 kilograms (110,000,000 pounds).[3] Compensating for the chlorine share of the industrial molecules, this means that the potential BMDS launch impact represents about .4% (.004) of the U.S. contribution to ozone depletion.

However, the industrial "emissions" are actually the residuals of production and use of chemical which have been phased out, under the Clean Air Act Amendments of 1990 and a series of international protocols. That is, these substances are already in the environment; nothing can be done to put them back in the bottle. Thus, each year stratospheric releases of rocket fuel exhaust become a larger fraction of the problem, as fewer industrial ozone-depleters are manufactured.

More important, the fractional contribution of rocket-launches to ozone depletion does not make it desirable. It is as large as all but the largest industrial releasers, before the phase-out took effect, and orders of magnitude larger than the releases from a home refrigerator or a car air conditioning system. Our environmental laws and policies do not excuse pollution simply because there are other, larger sources. That is, if I were a repairer of air conditioning systems, I could not—and should not—release chlorine-containing refrigerants into the atmosphere simply because a Titan or Delta launch vehicle emits much more chlorine.

For those unfamiliar with the working of our environmental laws, an analogy in criminal law might be instructive. We don't legalize shoplifting simply because some people conduct million-dollar armored car heists. We may tailor our response to the crime, but we don't say it's acceptable.

Similarly, with the release of ozone-depleting compounds to the atmosphere, we as a society might decide that we shouldn't abruptly end space launches that depend upon solid rocket propellant. Instead, we might set a goal for the deployment of alternatively fueled rockets. The PEIS considers no such goal, despite the urgent need to mitigate global ozone depletion.

The Defense Department, NASA, and others have conducted research on propellants designed to achieve the thrust of ammonium-perchlorate-based fuels without the environmental hazards, but these efforts are poorly funded, and there appears to be no urgency. The BMDS program should at the very least, in its PEIS, evaluate the mitigation of seriously harmful environmental consequences through the development and deployment of alternative solid rocket propellants.

~~[3]"Inventory of U.S. Greenhouse Ga~~s Emissions and Sinks: 1990-2001," EPA 430-R-03-004, April, 2003. http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2003.html. Note that these numbers overstate the actual chlorine mass in these emissions, but they exclude less destructive substitute compounds.

Perchlorate Releases

In 1990, when I wrote my report, "No Free Launch,"[4] I focused on the exhaust emissions from solid rocket motors. For the past several years, however, another environmental catastrophe, the pollution of our nation's drinking water with perchlorate, has emerged as a comparable challenge. As many as 20 million people are today drinking water containing perchlorate from rocket fuel production, and hundreds of wells have been taken out of service to avoid further public exposure.

Even in low concentrations, perchlorate in drinking water and food poses a threat to public health, particularly for newborns and other young children. U.S. EPA explains:

> Perchlorate interferes with iodide uptake into the thyroid gland. Because iodide is an essential component of thyroid hormones, perchlorate disrupts how the thyroid functions. In adults, the thyroid helps to regulate metabolism. In children, the thyroid plays a major role in proper development in addition to metabolism. Impairment of thyroid function in expectant mothers may impact the fetus and newborn and result in effects including changes in behavior, delayed development and decreased learning capability. Changes in thyroid hormone levels may also result in thyroid gland tumors. EPA's draft analysis of perchlorate toxicity is that perchlorate's disruption of iodide uptake is the key event leading to changes in development or tumor formation.[5]

Rocket fuel wastes, from manufacturing, testing, training, maintenance, and decommissioning are a significant environmental hazard. This is a front page news story from California to Massachusetts, but it is barely mentioned in the PEIS.

Where it is mentioned, the authors understate the risks of exposure:

> It is now known that perchlorate's direct effects on the human body are limited to the thyroid gland, and only if ingested at very high levels for a prolonged period of time (typically years). Peer-reviewed studies suggest that perchlorate in drinking water below 200 parts per billion has no measurable effect on human health. These findings provide reason to believe that low levels of perchlorate (below 200 parts per billion) also have no measurable effect on pregnant women or fetuses. (Council on Water Quality, 2003) Currently there are no Federal drinking water standards for perchlorate. (4-56)[6]

[4]Lenny Siegel, "No Free Launch: The Toxic Impact of America's Space Programs," National Toxics Campaign Fund, August 1, 1990.

[5]"Perchlorate: Frequently Asked Questions," U.S. EPA, August 5, 2004. http://www.epa.gov/safewater/ccl/perchlorate.html

[6]Note: The cleverly named Council on Water Quality is an association of companies that have released perchlorate pollution into the environment, not a government agency or an unbiased observer.

The reason that there is no federal drinking water standard for perchlorate is that the Defense Department objected to EPA studies that suggested a standard of one part per billion (ppb). Meanwhile, regulatory agencies are using levels far below the 200 ppb asserted in the PEIS. On the way to establishing its own legal standard, California has adopted a Public Health Goal of 6 ppb.[7] In May, 2004, Massachusetts identified a reference dose for perchlorate that would correspond to a 1 ppb drinking water exposure limit. It too is close to promulgating a binding standard.[8] And while U.S. EPA will not promulgate a standard until after the National Academy of Sciences has completed its review, in the interim it has instructed its personnel to use an action level range of 4 to 18 ppb.[9]

The PEIS should offer estimates of the quantities of solid rocket fuel that will be manufactured for the BMDS, not just for testing, but for missiles that will be deployed and hopefully never be launched. From that figure, it can estimate the quantities of manufacturing waste—propellant flakes, chips, and wastewater—likely to be generated. The PEIS estimates that the BMDS program will launch 413 solid-propellant rockets, containing from under 500 kilograms (1,102 pounds) to 60,000 kilograms (132,277 pounds) of solid propellant each. About 70% of that propellant, by weight, will consist of ammonium perchlorate. But nowhere does it estimate what quantity of propellant will be contained in deployed missiles, or even how many missiles will be part of that system. Without that information there is no way to project the amount of propellant waste likely to be generated by the program.

Propellant Disposal

Disposal of missile propellant, for both refurbishing and decommissioning, is a significant financial and environmental cost. NEPA provides the opportunity to weigh those costs before system acquisition, so technological choices that minimize such costs can be considered. The Government Accountability Office (formerly the General Accounting Office) wrote:

> DOD regularly disposes of missiles and has an amount for disposal costs included in its annual budget request. Thus, because it is known at the time of acquisition that costs will be incurred for missile disposal, the probability criterion for recording a liability is met. The Congress has also recognized that disposal costs will be incurred and has emphasized the importance of accumulating and considering this information. For example, the National Defense Authorization Act for Fiscal Year 1995 requires the Secretary of Defense to determine, as early in the acquisition process as feasible, the life-cycle environmental costs for major defense acquisitions programs, including the

[7] "~~Frequently Asked Questions (FAQ~~s) About the Public Health Goal for Perchlorate," California Office of Environmental Health Hazard Assessment (OEHHA), March 11, 2004.
http://www.oehha.ca.gov/public_info/facts/perchloratefacts.html
[8] "Perchlorate: Toxicological Profile And Health Assessment," Massachusetts Department of Environmental Protection, Office of Research And Standards, Final Draft, May, 2004.
http://www.mass.gov/dep/ors/files/perchlor.pdf.
[9] Marianne Lamont Horinko, Assistant Administrator, "Memorandum: Status of EPA's Interim Assessment Guidance for Perchlorate," U.S. EPA, January 22, 2003.
http://www.safedrinkingwater.com/community/2003/021203perchlorate_memo.pdf

> materials to be used and methods of disposal. The life-cycle cost estimates are required before proceeding with the major acquisition.[10]

Solid rocket fuel, when deployed in missile systems, does not last indefinitely. It has a shelf life. Both strategic and tactical missiles must be de-fueled and re-fueled or replaced periodically. By 2009, the Army will need to demilitarize over 102,000 Tube-launched, Optically-tracked, Wire-Guided (TOW) tactical anti-tank missiles, and by 2015 over 306,000 Multiple Launch Rocket System (MLRS) rockets will also require demilitarization. These weapons contain over 45,000,000 pounds of ammonium perchlorate, as well as nearly 1,200,000 pounds of RDX and HMX, two other energetic contaminants.[11]

Other missiles become obsolete and require replacement. The Navy reportedly destroyed more than 350 Poseidon Sea-Launch Ballistic Missile second stage motors, each containing 17,000 pounds of solid propellant—about 6,000,000 pounds total—at Hill Air Force Base in Utah, and it is scheduled to be about a third of the way into the destruction of 800 larger Trident I rocket motors.[12]

GAO did not separate disposal requirements for refurbishing from disposal for decommissioning. In 1998, it tabulated over 574,000 missiles and 5,871 large solid rocket motors in the Defense Department inventory, most of which would require disposal.[13]

Yet the PEIS appears not to address the environmental aspects of missile maintenance and it gives only cursory mention to decommissioning:

> Decommissioning of missiles would first require the removal and proper disposal of liquid, solid, or hybrid (liquid and solid combination) propellants from the booster(s). Where possible, propellants would be recovered and reused. Aging motors that contain flaws would likely be decommissioned using open detonation.… Solid rocket propellant would be removed for reclamation or burning in a controlled environment, such as an incinerator. Where practicable, incineration or closed burning of rocket propellant would be performed. Most of the acid and particulates ejected during the burn would be collected in plume scrubber water. This water would be treated for acceptance by a publicly owned (or federally owned) water treatment works in accordance with a National Pollutant Discharge Elimination System (HPDES) permit. (p. 4-16)

Once again, the PEIS authors don't seem to be reading the newspapers. The disposal of solid rocket propellant through "hog-out" (washing out the propellant) or open burning/open detonation are some of the major sources of perchlorate contamination across the country. The

[10] "Financial Management: DOD's Liability for Missile Disposal Can Be Estimated," U.S. General Accounting Office, GAO/AIMD-98-50R, January 7, 1998, page 6.
[11] "Reusing and Disposing of Missile Munitions: Phase 2," U.S. Army Audit Agency, AA 02-145, February 25, 2002, pages 20-21.
[12] "Hill AFB to Destroy 800 Trident Motors, Project Expected to Last 17 Years," *Defense Cleanup,* June 19, 1998, page 4.
[13] "Financial Management," page. 8.

PEIS should note how much propellant will be used, how often it will be necessary to dispose, and what the environmental impacts of each disposal or treatment method are likely to be. Such information is necessary, not just to estimate the life-cycle costs of the program, but also to figure out in advance how to reduce financial costs and environmental impacts through system redesign or ongoing mitigation activities. That's the purpose of the NEPA process.

To its credit, the Defense Department has developed better technologies for treating and recycling solid rocket propellant. For example, the Army Aviation and Missile Command's Research, Development, and Engineering Center uses super-critical ammonia to process and reclaim the ammonium perchlorate from solid propellant. The Hawthorne Army Depot, Nevada, has installed a prototype biodegradation system processing wastewater containing ammonium perchlorate.[14]

However, the Defense Department does not currently have the capacity to dispose of its current missile demilitarization and disposal inventory by any method, let alone the dispose of solid-propellant in an environmentally sound manner.

- Thermal treatment can release dioxins into the atmosphere. Even at very low concentrations, these compounds are a global, persistent threat to public health.
- Open burning and detonation often releases perchlorate into soil and groundwater.
- Recycling means that significant quantities of perchlorate are likely to be used in construction and mining. However, evidence is emerging—from Westford, Massachusetts, for example—that such uses may be generating unacceptable levels of pollution, as well.[15]
- Treatment systems installed to date lack the capacity to treat all the solid or liquid wastes likely to be generated by BMDS manufacture, maintenance, and decommissioning.

Overall, the PEIS puts off consideration of the challenge of waste decommissioning, stating, "The environmental impacts associated with decommissioning of specific components would be more appropriately addressed in subsequent tiered environmental analysis…" (ES-20)

This is unacceptable. It can only lead to "end-of-pipe" solutions, even though the Defense Department's own environmental managers and specialists agree that environmental protection should be integrated into acquisition and even research and development. The 2001 Munitions Action Plan, for example, states:

> The current emphasis in acquisition of munitions of all types (air delivered, ground launched, and sea launched) is on improving accuracy, reliability and increasing distances between firing or launch points and targets (i.e., so-called standoff ranges). At the same time, the public and regulatory bodies are raising concerns about explosives safety and the environmental effects of muni-

[14] "~~Joint Demilitarization Technolog~~y Program," Department of Defense, October, 2003.
http://www.dtic.mil/biosys/org/demil_rept2003_final.pdf
[15] Carrie Simmons, "DEP: Westford 'Responsible' for Water Clean-Up," *Westford Eagle* (Massachusetts), September 30, 2004.

> tions. The DoD is also becoming more aware of the cleanup and environmental compliance costs associated with training, testing, demilitarization, and unexploded ordnance (UXO) responses.
>
> These developments have highlighted the need for DoD to address environmental and safety concerns, and costs, throughout the munitions life cycle. This cycle starts from the technology development and design phase to the end-state of use, UXO and munitions constituents cleanup on ranges, or demilitarization. Addressing these concerns early in the life cycle (during requirements definition and acquisition) has the potential to significantly reduce costs and avoid problems later.[16]

That is, if the review of the potential environmental impacts of a system such as the BMDS finds the potential for significant negative environmental impacts, then those designing the system, selecting programmatic alternatives, and managing its testing and deployment should continuously evaluate ways to minimize those impacts, from the beginning.

The PEIS should consider the environmental consequences of various disposal strategies so the BMDS program can develop the technology or capacity to address its waste or consider the use of alternative launch technologies or strategies to minimize either the waste or the negative environmental impacts.

Perchlorate Debris

The PEIS raises and then dismisses the potential environmental impacts from perchlorate debris from launch failure. Presumably the same issues arise if a missile is intercepted before burning all its fuel. It states:

> During flight termination or catastrophic missile failure of solid propellant boosters, pieces of unburned propellant could be dispersed over an ocean area of up to several hundred kilometers. Once in the water, ammonium perchlorate could slowly leach out and would be toxic to plants and animals. In freshwater at 20º C (68º F), it is likely to take over a year for the perchlorate contained in solid propellant to leach out into the water. (Lang et al, 2000, as referenced in U.S. Army Space and Missile Defense Command, 2003) Lower water temperatures and more saline waters would likely slow the leaching of perchlorate from the solid propellant into the water. Over this time, the perchlorate would be diluted in the water and would not reach significant concentrations. (U.S. Army Space and Missile Defense Command, 2003) (page 4-51)

The PEIS authors apparently not followed carefully the research of the Aerospace Corporations team, headed by V.I. Lang, mentioned in their text. This group, which has been

[16] *Munitions Action Plan: Maintaining Readiness through Environmental Stewardship and Enhancement of Explosives Safety in the Life Cycle Management of Munitions,* U.S. Department of Defense Operational and Environmental Executive Steering Committee for Munitions (OEESCM), November, 2001, page 16.

studying perchlorate releases from launch operations for the Air Force, concluded in their most recent report:

> As illustrated by our hypothetical case study, risks associated with the inadvertent release of perchlorate from accidental launch failures must be managed on a case by case basis because of the complexity of variables that can affect the release rate from propellants, and because each launch location has unique environmental characteristics. The same type of approach can be used to assess the risk of perchlorate releases from other operations where sold propellant may be dispersed.
>
> We recommend that a systematic approach to assessing potential impacts be used in the initial planning stages of a launch program, for example, in the AF Environmental Impact Analysis Process, which complies with the National Environmental Policy Act (NEPA). Regulatory agencies may require such analyses be performed prior to new launch programs. In this report, we have presented one type of step-wise approach to assessing perchlorate releases for a typical launch scenario.
>
> Initial studies performed by the University of Alaska on fish exposed to solid propellant in water samples, and in particular on fish exposed to perchlorate in water, indicate the potential for significant biological effects. Studies are also under way to determine the effect of released perchlorate on soil and plant species.[17]

The Army should follow the advice of the Air Force contractors and conduct site-specific analysis of the impact of perchlorate debris on any freshwater lake that might receive perchlorate debris as well as confined oceans waters, such as within the Marshall Islands, where repeated releases of perchlorate could damage sensitive ecosystems or essential food supplies. It should also work with NASA and the Air Force to ground-truth models on perchlorate releases by conducting actual water, soil, and sediment sampling for perchlorate at major launch facilities such as Cape Canaveral and Vandenberg Air Force Base.

Conclusion

To ensure maximum environmental protection and reduce known, widespread human health risks from the use and disposal of solid rocket propellant if the Ballistic Missile Defense System moves forward, the Programmatic Environmental Impact Systems for the Ballistic Missile Defense System should compare the proposed alternatives against a genuine No Action Alternative. At a minimum, to comply with the National Environmental Policy Act, it should::

[17]~~V.I. Lang et al, "Assessment of P~~erchlorate Releases in Launch Operations III," The Aerospace Corporation (No. TR-2003(1306)-2, prepared for the Air Force Space Command Space and Missile Systems Center (SMC-TR-04-11), September 18, 2003, page 27. This and other valuable Air Force/Aerospace Corporation studies on the likely environmental impacts of space launches may be found at http://ax.losangeles.af.mil/axf/studies/studypage.htm.

1. **Provide more detailed estimates of perchlorate waste likely to be generated by system development, testing, deployment, maintenance, and decommissioning *and* acknowledge emerging regulatory standards for perchlorate exposure.**

2. **Consider in detail the management practices—launch protocols, treatment technologies, etc.—necessary to mitigate the significant environmental impacts, including increased depletion of the stratospheric ozone layer and the likely release of perchlorate into groundwater, surface water, and soil.**

3. **Evaluate alternative launch technologies not based upon ammonium perchlorate.**

Based upon such additional environment review, which I believe is mandated by any fair reading of the National Environmental Policy Act and its implementing regulations, Program Managers should use the information generated to help evaluate all alternatives and to mandate actions to minimize or mitigate the serious environmental consequences associated with such a large and continuing use of solid rocket propellant. Such steps are necessary to protect the American people, the ostensible purpose of the Ballistic Missile Defense System.

DC_E0431

Johnson, Kathryn

From: jon.francine
Sent: Thursday, November 18, 2004 2:34 PM
To: mda.bmds.peis
Subject: PEIS Noise section comment

In Section 3.1.10 - Noise, there are numerous errors.

An increase of 1 dB is not a doubling of sound energy. Decibel are on a quasi-logrithmic scale and it does not function like the Richter scale. An increase of 3 dB is a doubling of sound pressure.

dBA is not used to assess human reaction to a single noise event averaged over a 24-hour period. dBA is measure of sound pressure using the A-weighted scale. Many other acoustical metric are used to assess human reaction, including Leq - equivalent noise level, sound exposure level, Ldn, etc.

It is obvious that this section was written by someone without knowledge of basic acoustics. This section should be re-done by an acoustician. If there is a complete misunderstanding of noise, how can the impacts be correctly assessed?

Jon

DC_E0439

Johnson, Kathryn

From: Jimmy L. Spearow
Sent: Monday, November 22, 2004 3:57 AM
To: bmds.peis@mda.osd.mil; mda.bmds.peis
Cc:
Subject: BMDS PEIS Comments: Correction of Typos

Dear MDA
1) Did the MDA extend the deadline for BMDS PEIS comments and organize additional hearings to enable citizens in regions more affected by the BMDS to attend hearings and comment? This was requested at the Sacramento hearing.

2) I discovered typos in the BMDS PEIS comments that I submitted earlier. If possible, could you replace my BMDS PEIS comments that I submitted a couple of days ago with my edited comments below. The edited typos are in parts of only nine sentences. If needed, I will be happy to indicate the edits.

Please let me know if you can substitute my BMDS PEIS comments below for the ones I submitted earlier.

Thank You and may you have a happy Thanksgiving holiday

Jimmy Spearow

Missile Defense Agency
BMDS PEIS
Comment Form

Name: Jimmy Spearow, Ph.D.
Ph, D. in Genetics,
With experience in Genetics, Physiology and Reproductive Toxicology
Member Physicians for Social Responsibility

Organization: United States Citizen

Address1:

Address2: e

Comments:

November 17, 2004

Dear US Missile Defense Agency (MDA);

Please consider the following comments on the Draft Programmatic Environmental Impact Statement (PEIS) of the Ballistic Missile Defense System (BMDS).

1) Addressing Scoping Comments: I submitted a number of comments, on the scope of the BMDS several of which appear to have not been adequately addressed in the draft BMDS PEIS. These will be addressed in each specific comment. As discussed with Mda officials at the Sacramento public hearing, the MDA should provide more time for additional individuals from the most affected regions, including California and Alaska to comment on the BMDS PEIS.

2) Security, freedom, civil liberties, prosperity, the rule of law and the defense of the US constitution and its environment are very important to me as a citizen of this great country. Environmental sustainability is indelibly tied to our prosperity, and more abstractly to our security and freedom. We all want to be safe from missile attack. However, I am very concerned about the interconnected environmental, security and arms proliferation consequences of the US Missile Defense Agency (MDA) plans to establish a vast land, air, sea, and space- based Ballistic Missile Defense System (BMDS) including interceptor and laser weapon systems, sensors and command and control communication systems. The BMDS presents a number of toxic contamination and exposure risks as well as risks to **health and safety** that must be considered under the National Environmental Policy Act (NEPA). In so many cases the BMDS PEIS under estimates the magnitude or importance of these risks. These underestimates of environmental effects will be discussed under specific comments.

3) The BMDS PEIS does not include a real "No Action Alternative". Such an alternative that does not include further development testing or deployment of these weapon systems needs to be considered and included in the PEIS. The BMDS PEIS has not considered the "No action Alternative" of re-joining the UN and many nations of the world in working to enhance security through treaties and arms control and disarmament approaches, e.g. the approach that has provided us with long-term security to date.

4) The BMDS does not consider the direct, indirect and cumulative effects of the BMDS as required by NEPA, especially in regard the effects of the BMDS on the Arms race, which puts us closer to the disaster of nuclear war. In this regard, the PEIS is completely lacking a non-proliferation analysis. The BMDS tries to sell missile defenses to the public as a way to go beyond nuclear deterrence. Yet the BMDS is a dramatic escalation of a missile defenses that is not relevant for defending from terrorists who are much more likely to smuggle WMD. Securing loose nuclear materials is a much more effective strategy for preventing such terrorist nuclear threats.
The BMDS PEIS ignores the fact that the US posses extensive offensive nuclear and conventional weapon systems and that the proposed BMDS will operate along side these offensive weapon systems. The BMDS PEIS ignores the fact that the U.S. has a preemptive nuclear and conventional first-strike warfare policy and has exercised this policy in preemptively / preventatively invading other countries that have not attacked the U.S. including Iraq. Pronouncements of US preemptive offensive nuclear and conventional first strike policy as articulated in the 2002 Nuclear Posture Review; the 2002 Defense Guidance Policy; many statements of Bush, Cheney, Rumsfeld, and Wolfowitz, as well as the unprovoked 2003 invasion of Iraq, have together furthered international fears of the prospect of unprovoked unilateral attacks by the US. Building a massive land, sea, air and spaced-based BMDS is very likely to further invoke international fears that it will be used in conjunction with US offensive first strike and command and control communication systems to attack and/or dominate other countries.

The BMDS PEIS ignores the reasonable forseeability that it forces other nations to proliferate and/or smuggle WMD so that they can re-establish deterrence. Indeed, Russia and China have already started to proliferate and develop counter measures in response to the impending development of the U.S. BMDS (Evans 2004). Previously non-nuclear nations such as North Korea have stated that they also proliferated in order to establish a deterrent. In short, many nations are concerned that a US BMDS will eliminate their ability to deter attack, and assure the ability of U.S. forces to intervene anywhere in the world with offensive weapons systems. Such fear and insecurity has a reasonable forseeability of driving WMD proliferation and thereby decreasing rather than increase our security for years to come.

Such WMD proliferation and the treat of nuclear war will have major environmental consequences. Thus, the BMDS needs a non-proliferation analysis which considers the direct, indirect and cumulative effects of the BMDS as well as other entities.

In essence, the combined direct, indirect and cumulative effects of the proposed BMDS in conjunction with US offensive weapon systems and US preemptive first strike military policy is very likely to invoke fear of US actions and intentions. Furthermore, a BMDS would be much more likely to be effective in intercepting ICBMs of another nation, if the BMDS were to be used following a preemptive nuclear first strike. Since the nation that strikes second loses for sure, the BMDS destabilizes the policy of nuclear deterrence that has helped to keep the peace for over 50 years. There is more than a reasonable foreseeability that the resulting paranoia will cause a major arms race, and push us into confrontations and wars of great scale. Such wars seriously threaten all we as a people hold dear; health, safety, and our environment.
The threat of the BMDS leading to a more aggressive nuclear policy and nuclear war can be seen in the historic article "Victory is Possible" by Colin S. Gray and Keith Payne, Foreign Policy Summer 1980, pp. 14-27. These authors state: "If American nuclear power is to support U.S. foreign policy objectives, the United States must possess the ability to wage nuclear war rationallyŠ.
"ŠThe United States should plan to defeat the Soviet state and to do so at a cost that would not prohibit U.S. recoveryŠ.
Washington should identify war aims that in the last resort would contemplate the destruction of Soviet political authority and the emergence of a postwar world order compatible with Western valuesŠ.
Once the defeat of the Soviet state is established as a war aim, defense professionals should attempt to identify an optimum targeting plan for the accomplishment of that goal. For example, Soviet political control of its territory in Central Asia and in the Far East could be weakened by discriminate nuclear targeting. The same applies to Transcaucasia and Eastern EuropeŠ.
Strategists cannot offer painless conflicts or guarantee that their preferred posture and doctrine promise a greatly superior deterrence posture to current American schemes. But, they can claim that an intelligent U.S. offensive strategy, wedded to homeland defenses, should reduce U.S. casualties to approximately 20 million, which should render U.S. strategic threats more credible. Š
A combination of counterforce offensive targeting, civil defense, and ballistic missile and air defense should hold U.S. casualties down to a level compatible with national survival and recovery. The actual number would depend on several factors, some of which the United States could control (the level of U.S. homeland defenses); some of which it could influence (the weight and character of the Soviet attack); and some of which might evade anybody's ability to control or influence (for example, the weather). Š
No matter how grave the Soviet offense, a U.S. president cannot credibly threaten and should not launch a strategic nuclear strike if expected U.S. casualties are likely to involve 100 million or more American citizens." Š (**Victory is Possible** by Colin S. Gray and Keith Payne *Foreign Policy*, Summer 1980, pp. 14-27).
Note that these authors also helped to write the 2002 US Nuclear Posture review, which further solidifies the US preemptive nuclear first strike policy. Gray and Payne make it clear that BMD is essential for a more aggressive US nuclear first strike policy. Thus, there is a reasonable foreseeability that the BMDS in conjunction with US offensive nuclear forces will increase the probability of a massive nuclear war. Thus, the BMDS needs to include a detailed analysis of the environmental effects of "limited" and "all out" nuclear war, including: medical radiological, blast, burn, fallout, disease, and cancer effects to health and safety; effects on nuclear winter, as well as effects on atmosphere, global supplies of fresh water, global food supplies, and nuclear power plants and power systems. The prospect of the BMDS leading to more aggressive US policies that result in a massive nuclear war also needs to be considered in regard to a true no action alternative.
In short, since there is a reasonable forseeability that the BMDS in conjunction with US and Allied nuclear weapon systems and current US nuclear weapons policy as defined in the 2002 Nuclear policy

review will destabilize the nuclear arms race and lead to nuclear war, the environmental consequences of nuclear war need to be considered in detail in the BMDS PEIS. (Ambio Volume XI number 2-3, 1982, Nuclear War: The Aftermath. Entire journal dedicated to the effects of nuclear war, including effects on heath and safety, Air, water resources, agriculture, biological resources, and nuclear winter.) This request in my scoping comments was ignored. e.g. Scoping comment "#18) The MDA needs to consider whether the BMDS in conjunction with offensive first strike weapon systems and first strike policy increase the probably of a major nuclear war or other disturbance that could result in nuclear Winter, with the associated loss of species"

5) **The BMDS PEIS did not adequately consider impacts of Hazardous waste and materials and on Health and safety, Water Resources and Biological resources of environmental contamination from toxic and hazardous components of rocket fuels and explosives.**
The BMDS PEIS markedly under reports the emissions of representative interceptors. Exhibit 4-11 reports the emission of (90+58+52+22+17+6+6)=251 pounds for a representative interceptor. However, ground based interceptors are much larger (approximately 54 feet long 3 stage solid propellant rockets (such as the Minuteman III) weighting 22.5 to 25 tons and containing approximately 30,000 to 45,000 pounds of solid propellant. Thus the MDA underestimates the emissions from such interceptor rockets by factor of greater than 100. This is totally unacceptable. This underestimate of BMDS pollutants is apparently repeated in Exhibits 4-13, 4-14 and 4-15. Thus the MDA needs to revaluate the environmental effects of these pollutants. Also the MDA should define what are the emissions from the missiles used to launch spaced based interceptors, and sensors.

6) Not only does the BMDS PEIS under represent the total amount of emissions, from the estimated 515 BMDS rocket launches over the next several years, it also discounts that this program will be injecting large quantities of chemicals including aluminum oxide, hydrogen chloride and hydrochloric acid into the upper atmosphere, stratosphere, etc. Most concerning is the injection of hydrogen chloride into the upper atmosphere where the breakdown of each hydrogen chloride molecule to chloride ion catalyzed the breakdown of 100,000 ozone molecules, thereby depleting ozone, and decreasing the blocking of UV rays. This depletion of ozone will increase risk of cataracts and skin cancer. Thus, the BMDS will have a much greater effect on ozone depletion and skin cancer than HCl released at sea level.

7) Liquid propellants containing hydrazines, nitrogen tetroxide, and other compounds are highly toxic. At very low concentrations, hydrazines irreversibly cross link to aldehyde groups on proteins at slightly acidic pH and can cause cancer. One of the most concerning pollutants from the firing of rocket engines is HCl, which combines with atmospheric water to produce acid rain. The PEIS did not address potential for interactions between HCl and hydrazines commonly used in rocket engines such as monomethylhydrazine (MMH) and Unsymmetric dimethylhydrazine (UDMH). Specifically does the toxicity of hydrazine increase under acidic conditions found in acidic rocket exhaust?

8) Ammonium perchlorate is one of the main components of rocket fuel, typically constituting 60% to 75% of missile propellant and about 70% of space shuttle rocket motors. Since the fuel and perchlorate goes flat, the fuel/perchlorate has to be replaced every few years or it will fail to function properly, thereby increasing the amount of perchlorate waste and exposure problems.
Ammonium Perchlorate is well characterized as a thyroid hormone disruptor.
http://www.ewg.org/reports/rocketscience/chap3.html . **At high enough concentrations, perchlorate can affect thyroid gland functions, where it blocks iodide uptake necessary for the synthesis of thyroid hormones (Urbansky 2002). Perchlorate can cause hypothyroidism, and thyroid cancer.** The environmental levels of perchlorate have been shown to inhibit development in frogs (Goleman et al. 2002). California has extensive perchlorate contamination problems with the drinking water sources of at least 7 million Californians and millions of other Americans are contaminated with perchlorate. A federal **safe daily perchlorate exposure has not yet been set by the**

EPA, and its expected release in 2002 has been delayed. It has been delayed since the DoD objected to EPA studies suggested a standard of 1 ppb. Senator Barbara Boxer has introduced legislation to require the EPA to establish a standard for perchlorate contamination by July 1, 2004. While most contaminated samples are in the 4 to 20 ppb levels, surveys of California water sources show several sites with perchlorate levels from 4 to 820 ppb.
http://www.ewg.org/reports/rocketwater/table1.php
Ammonium perchlorate used in solid propellants blocks the formation of key thyroid hormones which are critical for growth and development especially in fetuses and children. The PEIS proposes to allow over 30-fold higher levels of perchlorate (200 parts per billion) than that proposed by the State of California (6 parts per billion). As pointed out in the comments of Lenny Siegel: The reason that there is no federal drinking water standard for perchlorate is that the Defense Department objected to EPA studies that suggested a standard of one part per billion (ppb). Meanwhile, regulatory agencies are using levels far below the 200 ppb asserted in the PEIS. On the way to establishing its own legal standard, California has adopted a Public Health Goal of 6 ppb (Frequently Asked Questions (FAQs) About the Public Health Goal for Perchlorate," California Office of Environmental Health Hazard Assessment (OEHHA), March 11, 2004. http://www.oehha.ca.gov/public_info/facts/perchloratefacts.html). Even these levels of perchlorate may be detrimental to fetuses and infants. The human study considered in setting the California public health goal did not evaluate pregnant women, fetuses or infants (Greer et al. 2002). The study of Greer at al 2002, only used a 14-day exposure to perchlorate, which is insufficient to deplete thyroid colloid which acts as a storage form of thyroid hormones. Thus this study is insufficient to estimate the effect of long-term perchlorate exposure on iodine uptake or thyroid hormone levels. Since the effect of long term perchlorate exposure on reducing thyroid hormone levels, especially in the fetus and in infants has not been considered, the MDA needs to evaluate these effects on these sensitive groups as required by federal law. In May, 2004, Massachusetts identified a reference dose for perchlorate that would correspond to a 1 ppb drinking water exposure limit. Also note that perchlorate is found in milk and in several plant species, including lettuce, where high levels have been reported. Thus multiple sources of perchlorate exposure need to be considered.

9) To ensure maximum environmental protection and reduce known, widespread human health risks from the use and disposal of rocket propellants, the BMDS PEIS should compare the proposed alternatives against a real No Action Alternative. At a minimum the BMDS PEIS should:
A. Acknowledge and address emerging regulatory standards for perchlorate exposure.
B. Consider the effects of perchlorate on susceptible subpopulations, including fetuses, and children. The MDA also needs to consider the effects of perchlorate exposure on even more sensitive congenitally hypothyroid populations, so that these individuals are not detrimentally affected by perchlorate from BMDS missile launches.
C. Since water supplies in several regions of central and southern California are already at, exceeding and in some cases markedly exceeding the emerging regulatory standards for perchlorate, the MDA should acknowledge and address the perchlorate problem so as to protect the public.
10**) The BMDS PEIS did not address my scoping comments that the** PEIS should address whether BMDS testing and deploying interceptors endanger Health and Safety by their targeting the incorrect vehicle, e.g. civilian aircraft. The BMDS as described on the MDA web site is a risk to public safety as shown by the Patriot 3 (PAC-3) shooting down US and Allied British military planes during the 2003 US / British invasion of Iraq. According to a report in USA Today April 15, 2003, titled "Patriot Missile: Friend Or Foe To Allied Troops?" By Andrea Stone, It is seemed that the Patriot has difficulty determining "friend from foe". In the first incident, on March 22, a Patriot missile downed a British Tornado GR4 fighter-bomber near the Iraq-Kuwait border, killing the two-man British crew. A U.S. F-16 fighter jet had to fire on a Patriot missile radar in Iraqi after the radar "locked on" to the jet. A Patriot-3 battery was also suspected in the downing of a U.S. Navy F/A-18 Hornet near Karbala on April 2, killing the pilot. Since several other Patriot friendly fire malfunctions are known, the MDA needs to consider how many civilians will be killed by the patriot BMDS.

Furthermore, the Aegis Cruiser system is a threat to commercial aircraft, as shown by the USS Vincennes mistakenly shooting down the Iranian Airbus commercial airliner flight 655 on July 3, 1988, killing all 290 civilians aboard http://www.geocities.com/CapitolHill/5260/vince.html . Over 100 witnesses reported seeing an upward arching flash of light immediately before TWA flight 800 exploded off of New York. However, government investigators refused to consider whether a missile launched from an unannounced ongoing naval exercise could have been the cause of the crash. The point is that the activation of BMDS risks accidentally shooting down civilian airliners, which was not even considered in the BMDS. While the BMDS states that warning will be provided to enable time to clear the airspace, it is highly doubtful that such time would be allowed in a perceived emergency. The BMDS PEIS needs to address these threats.

Both the PAC-3 and Aegis Cruisers are included as components of the proposed BMDS Since the PAC-3 is a relatively short range system and is not designed for intercepting ICBMs, how many PAC-3 batteries will have to be deployed to offer full protection for the American and allied cities and military bases. Are these within range of any civilian aircraft? How will they discriminate attacking aircraft from commercial and civilian aircraft? The MDA needs to consider how many civilians and US/allied military personnel will be accidentally killed by the BMDS.

11) The PEIS provides conflicting information on the effects of the ABL on health and safety. The PEIS does not quantitatively assess the risk of the Airborne Weapons Laser (in a Boeing 747) blinding pilots and/or other civilians, stating mainly that humans and others would be exposed to the laser beam, mainly as reflected light for less than 0.01 seconds. However the PEIS provides no data on the wattage or power of these lasers in the PEIS making it impossible to assess the dangers of such laser exposure, especially to the eyes.
On Oct. 30, 1995, a Southwest Airlines' pilot in control of a flight departing McCarran International Airport in Las Vegas was temporarily blinded by a laser light. According to news reports, the incident was serious enough to force the plane's captain to take control until the pilot regained his sight. "Had it hit me and the other pilot simultaneously, I shudder to think what would have happened," the pilot told reporters. (http://www.fda.gov/fdac/departs/496_irs.html). Had the pilot been exposed to a high energy laser (HEL) as used in the BMDS the results could be much more debilitating, endangering the health and safety of numerous passengers.
The BMDS PEIS (page 4-32) cites that exposure to a reflected laser beam while in the air operating environment would be very short, < 0.01 seconds that and would not impact the health and safety (US Air Force 1997A). But no estimates are provided for the actual danger zone for the HEL to detrimentally affect health and safety, e.g. causing skin and especially retinal damage, if the HEL or other lasers are directed at plants, animals, or people. The Draft Supplemental Environmental Impact Statement for the Airborne Laser Program (2002) (page 99) cites the power of the HEL as about 10 million watts per square centimeter. Ten million watts per square centimeter will burn retinas and eyeballs very quickly. The PEIS states that medium energy lasers such as the SHEL if focused at point 12 km away, would be hazardous to the human eye 2 km before to 2 km past the focus point. Where as, the other lasers and especially the HEL would be hazardous immediately after leaving the turret of the ABL. While the PEIS states that the BILL and TILL no hazard distance would extend > 10 km beyond the target, and the HEL hazard distance would extend even beyond these distances. But the BILL, TILL and I presume the HEL hazard distances are apparently classified. How can the public comment on the effects of the BILL TILL and especially the HEL on health and safety if the of distance at which these lasers cause eye damage is not available? The public and the MDA / Air force need to make this information available to better ensure the heath and safety of the public.

The PEIS focuses on the testing of these lasers, but fails to reveal whether once deployed, the ABL or any other BMDS weapons lasers will ever be directed toward aircraft including airliners, or individuals on the surface of the earth, e.g. on land or at sea. If so, the MDA needs to address the effects of HEL

and other weapons lasers on endangering health and safety, especially skin and eye damage.
12) The MDA PEIS needs to consider whether boost phase BMDS interceptors could be launched erroneously, causing another country to believe it was under attack, and thereby triggering a nuclear war. The American Physical Society examined the issue of boost phase intercept, and determined that the interceptor has to be very close to the ICBM, be launched within about 15-60 seconds from the time the ICBM was launched, and have much greater accelerations than the ICBM http://www.physicstoday.org/vol-57/iss-1/p30.html (Kleppner et al. 2004). The problem of boost Phase intercept is greater for solid rockets with high accelerations than for slower accelerating liquid rockets. The further problem is that ship based interceptors are not big enough and do not have sufficient accelerations to make a boost phase intercept even from a small country like North Korea. If it did intercept, it is likely the warhead would not be destroyed by a kinetic hit-to-kill interceptor and would continue on to near its intended destination. Finally, they point out that a boost phase launch intercept of a ICBM from North Korea would likely occur over northern China, further risking causing China to think it was under attack by the US which could cause a nuclear war (Kleppner et al. 2004). The BMDS needs to consider the realities of the limitations of any BMDS relative to a real no-action alternative of working toward disarmament through arms control treaties.

13) Space debris from high altitude, mid-course missile intercepts or destruction of satellites. The PEIS does mention that even tiny particles of space debris traveling at extremely high speeds in orbit can destroy space suits, rockets and satellites. While the PEIS correctly points out that debris from low orbital intercepts will decelerate once it hits the atmosphere, and thereby de-orbit. However the PEIS fails to consider the space debris from high altitude intercepts which risk producing space debris that could make space unusable for many years. While the PEIS considers testing the BMDS on "targets of opportunity", no mention is made of space debris resulting if other nations target US BMDS satellites or components in high orbit as "targets of opportunity". This must be considered since the resulting space debris could destroy objects in space, making space unusable as well as violating the 1967 space treaty.

14) The environmental consequences of many rocket launches needed to deploy and maintain space-based interceptors has not been adequately considered, nor has the environmental consequences of their fuel. Will space-based satellites/interceptors use nuclear power sources? Will any BMDS interceptors ever use nuclear warheads? While nuclear tipped-interceptors are not mentioned in the PEIS, per se. In Section 2.2.1.1 the PEIS does mention the possibly of destroying a missile by using interceptors with directed blast fragmentation kill vehicles. However the PEIS, fails to reveal the nature of the blast fragmentation device, which is needed for evaluation of its environmental effects. Instead the MDA PEIS states that "the interceptors will be discussed and analyzed for environmental impacts at the booster and kill vehicle level. This will allow the MDA the flexibility to configure new interceptors based on boosters and kill vehicles analyzed in this document to address new or emerging threats." This does not allow a satisfactory evaluation of the hazards of the BMDS components. What blast fragmentation devices will be used? The PEIS needs to include the details of chemical and toxicant use and exposure.

15) Radioactive and/or biological weapons fallout from intercepted missiles has not been considered in the PEIS. If a kinetic hit to kill interceptor knocks out an ICBM in the mid phase or terminal phase, the nuclear warhead or its fragments are going to produce a tremendous amount of radioactive contamination where ever they land. Such radioactive fallout will clearly have major, highly deleterious effects on adults, children, and especially on developing embryos, and fetuses. While such an interception is very likely to be highly preferable to damage resulting from an air or ground burst over a city, the resulting radioactive contamination needs to be considered. The effects of war are normally excluded from analysis by the National Environmental Policy Act (NEPA). However, the proposed BMDS action is very likely to provoke a worldwide WMD arms race, and force other nations to prepare to launch a massive retaliation against the US should war ensue. Thus, these effects need to be

considered relative to a real no action alternative. Since the proposed BMDS is very likely to cause a massive arms race, the environmental consequences of a resulting War involving nuclear or other WMD should not be ignored. The PEIS needs to consider the environmental effects of fallout from intercepted WMD as well as the effects of WMD the BMDS fails to intercept. Thus PIES needs to consider these hazardous waste and materials issues. Appropriate references include "The Effects of Nuclear Weapons, Compiled and Edited by Samuel Glasstone and Philip Dolan, third Ed. DOD, DOE. 1977.

The American Physical society also identified the issue that boost phase intercept has a high probability of munitions carryover. A successful boost phase intercept is unlikely to disable ICBM's warheads or munitions. They will be deflected only slightly, if at all, and will continue on ballistic trajectories (Kleppner et al. 2004).

16) Will any interceptors use nuclear warheads? The PEIS does not address the inability of mid-course or terminal kinetic interceptors to stop a "threat cloud" once a attack missile has MIRVed, or released many decoys or countermeasures (Richard L. Garwin. Holes in the Missile Shield. Scientific American, November 2004, page 70-79). The MDA may be temped to intercept such a threat by using large nuclear tipped interceptors. The potential use of nuclear tipped interceptors was discussed by high ranking US DOD officials in 2002 http://www.washingtonpost.com/ac2/wp-dyn/A28866-2002Apr10?language=printer. If such nuclear tipped interceptors were deployed, the environmental risks would be much greater. If so, the environmental consequences of the nuclear fallout and electromagnetic pulses from such high altitude nuclear detonations must be considered in detail. This would include analysis of risks to health and safety, contamination of water, land, soils, EMP effects on civilian and medical electrical and computer systems and infrastructure. The MDA should also consider the effects of radioactive fallout on health and safety, biological resources, and contamination of land and water resources.
Furthermore, given the historic 15% missile launch failure rate, the radioactive fallout from accidents with nuclear tipped interceptors must be considered in detail. The public should have full opportunity to consider and comment on the use of such nuclear tipped interceptors in this PEIS. The point is that the blast fragmentation devices need to be described in detail to enable adequate evaluation of its environmental effects.

17) Also note that the technology and environmental effects of "advanced systems" remain to be defined. How can the environment effects of an undefined "advanced system" be evaluated in this PEIS? A full environmental analysis is needed for each component of the PEIS to be added. If any component of the BMDS will ever use nuclear warheads in any interceptors the MDA needs to thoroughly consider the environmental effects, as discussed above.

18) Will any MDA interceptors or Lasers use anti-matter weapons? A US Air Force anti-mater weapons research programs has recently been described in the SF Chronicle http://sfgate.com/cgi-bin/article.cgi?file=/c/a/2004/10/04/MNGM393GPK1.DTL. IF the BMDS will use antimatter weapons or energy sources, the environmental effects including the health and safety risks, and chemical exposure risks need to be described in detail.

19) **The BMDS PEIS needs to consider direct, indirect and cumulative effects of the proposed project in conjunction with other federal offensive military weapons systems and policies were not addressed**, but need to be addressed. The National Environmental Policy Act (NEPA) (http://ceq.eh.doe.gov/nepa/regs/nepa/nepaeqia.htm) and especially **The Regulations for Implementing NEPA** (http://ceq.eh.doe.gov/nepa/regs/ceq/toc_ceq.htm), state that both the direct and indirect effects of the proposed project as well as the Cumulative impact of the project should be considered. Sec. 1508.7 States that the "Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably

foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
In the context of this global ballistic missile defense system, the cumulative impact of reasonably foreseeable future actions of the US as well as other nations, agencies and persons need to be considered. Yet the reasonable foreseeable actions of other nations and individuals responding to the BMDS by proliferating WMD was not considered by the MDA in this PEIS.
As stated in Sec. 1508.8 "Effects" include:(a) Direct effects, which are caused by the action and occur at the same time and place and (b) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Effects and impacts as used in these regulations are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.
Thus, by law the MDA also needs to consider the Direct, Indirect and Cumulative impacts on the environment of the proposed BMDS along with other US offensive weapons systems and stated & demonstrated US preemptive first-strike policy.

The following points are points that need to be considered in the no action alternative.
20) The PEIS needs to consider whether the BMDS will result in Proliferation of Weapons of Mass Destruction (WMD) and an arms race in space. The response of other nations to the BMDS has not been considered. Specifically, the BMDS is coupled to other offensive weapons programs and will force other nations to proliferate and/or smuggle WMD so that they can re-establish deterrence. Relatively inexpensive countermeasures to BMD will likely thwart the goals of BMD. Such proliferation coupled with increased international tension will decrease rather than increase our security and lock us in to an expensive and destabilizing arms race and will have devastating long-term environmental consequences.

21) Alternative 3: Not developing, or building the BMDS or any of its components and instead renegotating an expanded and verifiable ABM / BMDS treaty: The ABM treaty helped to stabilize and de-escalate the nuclear arms race for all of its 29 years of existence. No country dared attack the US with nuclear missiles, in part because the U.S. would know exactly where the missile came from and have the clear ability to retaliate and bomb them into obivilion. That is certainly still the case. This option would preserve deterrence and peace. Yet it would enable the nuclear nations to abide by the NPT and reduce the overall level of nuclear weapons, in exchange for non-nuclear nations not developing nuclear weapons.

22) Alternative 4: Preserving Space for non-military purposes. The MDA should consider the alternative of not militarizing space. The planned US militarization and domination of space as described in the US Space Command Vision for 2020 (http://www.fas.org/spp/military/docops/usspac/lrp/ch02.htm) and as described in the 2002 US defense guidance policy and elsewhere, will certainly create and intensify conflicts over the control of space for years to come. These US policy documents talk about "Full Spectrum Domination", "negating" or "destroying" the enemy's satellites and use of space. As US citizens we would like for the US to protect space from militarization, but do we want the US to dominate space, and to start a series of space wars? Think about how you would feel if you lived in another nation and some one destroyed your satellites. Would such actions be considered an act of war?
Additionally how does the BMDS PEIS affect US compliance with the Outer Space Treaty?

23) Alternative 5: Deployment of a much more limited land and or Sea based theatre BMD that

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would offer protection from attack by short or intermediate range missiles. For example, rather than develop the extensive land, Sea, air and space based system, the US and its allies could instead deploy a currently available Aegis missile cruiser(s) off of North Korea. Such a small, affordable, alternative system would immediately meet the needs of defending Japan against missiles that might be launched by North Korea without invoking fears that it would be used to enable invasions and/or domination of the world and thereby starting a massive global arms race.

24) NONPROLIFERATION ANALYSIS COMMENT
Based on my expertise in the area of genetics, physiology, toxicology and nuclear weapons control/non-proliferation, it is a **reasonable foreseeability** and in my opinion a very high probability that the proposed BMDS creates a significant risk of nuclear and biological weapons proliferation. This proliferation risk goes hand in hand with a greater security risk, and both increase the potential harm to the environment and the public.

As pointed out by Nicole C. Evans, National missile defenses may undermine strategic stability by threatening the ability of other countries to retaliate, which is the core of their deterrence. Theater missile defenses do not pose this danger (Evans 2004). Evans goes on to describe Russian and Chinese concerns to National Missile Defense (NMD) and especially Global Missile Defense (GMD) as described in the BMDS PEIS. She also describes how Russia and China have already started to proliferate in response to the US renigging on the ABM treaty and preparing to deploy GMD, e.g. the BMDS.

Evans points out that; "Russia and China share two key concerns about American missile defense plans: that their nuclear deterrent is threatened and that American missile defense plans will destabilize arms control. Š
Both Russia and China have responded actively to the American abandonment of the ABM Treaty by developing asymmetrical measures to neutralize any potential threat. By withdrawing from START II, Russia was able to continue deploying multiple independently targetable reentry vehicles (MIRVs) on intercontinental ballistic missiles (ICBMs). Putin announced in October 2003 that Moscow intends to place on combat duty dozens of MIRVed SS-19s, and Russia has also extended the service life of its SS-18 heavy ICBMs. Russia has begun building the fourth-generation *Borey* class of submarines, is MIRVing its silo-based Topol-M, and is finishing testing the mobile version of the Topol-M." In February 2004 Russia also "successfully tested a new hypersonic "Crazy Ivan" warhead that follows a nonclassical scenario, changing flight altitude and course repeatedly, making it nearly impossible to track and target." Evans also points out that "Russia has also upgraded the A-135 strategic single-site ABM system covering Moscow, the only such system currently in operation. In 2002, Russia began working in earnest on TMD and is currently developing several advanced missile interceptors (Evans 2004).

Evans points out that "Both Russia and China appear unconvinced by American assurances that global missile defense is not directed against them, despite echoing American rhetoric about the need to defend against the terrorist threat. Senior Russian military and foreign affairs officials have argued that while the United States proclaims its partnership with Russia, its actions show anything but that. ŠRussian concerns are further aggravated by America's stated intention not to cut its nuclear arsenal to levels designated by the Moscow Treaty of May 2002--instead moving the missiles as well as the warheads into storage as a hedge against an uncertain future." (Evans 2004).

Evans then goes on to describe how China is responding to the US BMDS threat and "is moving toward a more diversified, invulnerable, and combat-ready operational nuclear triad." "Second, Russia and China are very concerned that American missile defense plans will destabilize existing arms control regimes and forestall future agreements."

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Russia, China, and other states express deep concern about the weaponization of space. In 2003, Russia and China proposed an agreement for the non-weaponization of space, and negotiations continue at the Conference on Disarmament in Geneva. Both Moscow and Beijing maintain that nonproliferation measures and policing regimes are a better way of dealing with weapons of mass destruction than attempts to develop missile shields" (Evans 2004).
Evans Concludes "The real danger lies in the potential of GMD to disrupt delicate regional balances and to encourage the further development and deployment of nuclear weapons. The United States, China, and Russia have all stepped up their offensive weapons programs since the dissolution of the ABM Treaty. The danger has been succinctly summarized by Mohamed El Baradei, head of the International Atomic Energy Agency: "If we don't stop using double standards, we shall be piled high with an even greater number of nuclear weapons." That would create the exact opposite of the professed objective of global missile defense: security for all who want it" (Evans 2004). This article and several others by Arms Control experts show evidence that the BMDS is causing and will continue to cause WMD proliferation rather than preventing it. **Thus, a non-proliferation analysis is needed for the BMDS PEIS particularly in regard to a genuine no action alternative.**

The BMDS PEIS (page 2-68) provided a justification based on politics rather than on analysis of environmental policy as the rationale for not considering a real "No Action Alternative", namely the canceling of Ballistic Missile Defense Capabilities (and re-engaging in treaty - based arms reductions). On page 2-68 the PEIS states " As suggested to the MDA during the scoping process, one alternative would involve canceling the development of all ballistic missile defense capability development and testing. Such an alternative would rely on diplomacy and military measures to deter missile threats against the U.S. However, this proposed alternative would eliminate the capability to defend the U.S., it's deployed forces, allies or assets for a ballistic missile attack should diplomacy of other deterrents fail. This alternative does not meet the purpose of or need for the proposed action as described in Sections 1.3 and 1.4, respectively; does not meet the direction of the President and the U.S. congress; and therefore will not be analyzed further."
A mainly political justification was also given on BMDS PEIS pages 1-14 for not considering scoping comments showing "concern that the BMDS would create an arms race, especially in space" Š comments showing "opposition to the development of nuclear weapons and concern that missile defense could be a first strike capability for U.S. worldwide military domination". Specifically, the MDA PEIS stated the rationale for excluding these comments is that "Public comments concerning DoD policy, budget and program issues are outside the scope of the Draft BMDS PEIS".
These political justifications used by the MDA are insufficient for excluding these and related issues of non-proliferation from analysis in the BMDS PEIS. A non-proliferation analysis is needed for the BMDS. We all want to be safe from missile attack. The non-proliferation analysis is needed to determine if the BMDS is likely to ultimately increase our security, and maintaining environmental quality or result in an out of control arms race that decreases our security and wreaks wide spread environmental destruction.
Because of the reasonable foreseeability of increased potential for environmental harm due to proliferation and security risks, I strongly recommend that the MDA prepare a detailed Nonproliferation Impact Review for the BMDS PEIS including a Nonproliferation Impact Review EIS for each BMD component and for each BMD site or location. These reviews will determine the scope and need for a MDA high-level program and the alternative that would cause the least environmental harm. If the BMDS is the best alternative for such a program, these review processes will thoroughly assess the potential proliferation, security and environmental harms and ways to mitigate those potential harms. This will mean that proactive plans to protect the environment, public safety and national security will be developed in advance rather than in response to a problem, accident or crisis.

DOE Programmatic EIS Precedent

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The DOE has set an important precedent by conducting a Programmatic EIS, including a Nonproliferation Impact Review (NIR), for its Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, including the Role of the Fast Flux Test Facility in December 2000 and for its Stockpile Stewardship and Management in September 1996. Furthermore, Nonproliferation Analyses were conducted in the following DOE EIS or Site-Wide EIS review documents:

· Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling (October 1995); Section 1.5.6 Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel, Page 1-10.

· Final Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site(August 1998);

·Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor (March 1999).): 1.3.5
Nonproliferation, Page 1-9 and 1-10.

Final Site-Wide Environmental Impact Statement for the Y-12 National Security _ _Complex_ (September 2001): Section 2.2.3 Nonproliferation and National Security, Page 2-7.

Following this precedent, the MDA BMDS, in my opinion, necessitates an equally comprehensive review. Such a Nonproliferation Review Should Include Public Hearing, Scoping and Comment.

25) I highly recommend that the Nonproliferation Impact Review be conducted like the NEPA process that includes public participation in the scoping phase and a draft document circulated for public comment. This open process is critical because intent really is the biggest differentiating factor between defensive and offensive military research. The participation of individual citizens who live near the proposed facility and have personal concerns such as health and property values, as well as representatives from professional and nonprofit groups who specialize in public health, emergency response, sewage treatment, landfills, water, environment, toxicology, science, medicine and arms control may identify unforseen problems, more cost-effective solutions and new ways to open up the process while maintaining necessary security. This scrutiny and public debate can only improve the quality of the decision-making process and will likely result in more confidence in the final decision on the part of those most directly impacted.

26) Which government and university institutions in the State of California will be conducting research to support the BMDS research and development and, if so, please describe their roles, responsibilities and the specific projects they will be involved in? Specifically, will Lawrence Livermore National Laboratory, Lawrence Berkeley National Laboratory, Sandia National Laboratory -- Livermore, or the University of California at Berkeley, Davis or Los Angeles be conducting research or development on the BMD for the MDA or DoD and, if so, what specifically will each that is involved be doing? This is important for people in these areas to know in order to understand, consider and evaluate the possible environmental, health, and safety impacts on their communities.

Thank you for considering these public comments on the BMDS PEIS.

Please confirm that you have received my comments.

Jimmy L. Spearow, Ph.D.

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"We must abandon the unworkable notion that it is morally reprehensible for some countries to pursue weapons of mass destruction yet morally acceptable for others to rely on them for security and indeed to continue to refine their capacities and postulate plans for their use." Mohammad ElBaradei, IAEA Director General (http://www.wagingpeace.org/articles/2004/03/26_road-prolilferation.htm)

Additional References:

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Ambio Volume XI number 2-3, 1982, Nuclear War: The Aftermath.

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Jimmy L. Spearow, Ph.D.

DC_F0003

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF ENFORCEMENT AND COMPLIANCE ASSURANCE

November 17, 2004

Missile Defense Agency
Ballistic Missile Defense System PEIS
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Dear Mr. Lehner:

In accordance with our responsibilities under Section 309 of the Clean Air Act and the National Environmental Policy Act (NEPA), the Environmental Protection Agency (EPA) has reviewed the Missile Defense Agency's (MDA) Ballistic Missile Defense System (BMDS) Draft Programmatic Environmental Impact Statement (DPEIS) (CEQ # 040438).

The DPEIS identifies, evaluates and documents, at the programmatic level, the potential environmental impacts of activities associated with the development, testing, deployment, and planning for the eventual decommissioning of the BMDS. It considers the current technology components, support assets, and programs that make up the proposed BMDS as well as the development and application of new technologies.

EPA commends the efforts that MDA has commenced in producing such a comprehensive and well organized document. We also appreciate your efforts in utilizing the extensive environmental analysis that is available for many of the existing components of the proposed BMDS. Based on our review of the DPEIS, we have rated the document as LO - Lack of Objections (see attached "Summary of EPA Rating System"). Although EPA has no objections to the proposed action, there are a few issues that should be clarified.

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1) General Comments:

a. To assess the impacts of implementing the proposed BMDS, the DPEIS characterized the existing condition of the affected environment in the locations where various BMDS implementation activities are proposed to occur. MDA has determined that activities associated with the proposed BMDS might occur in locations around the world. Therefore, the affected environment has been considered in terms of global biomes, broad ocean areas, and the atmosphere. This has resulted in the DPEIS being very conceptual and general in nature. EPA understands that once potential BMDS locations are determined, more detailed site-specific documents will be prepared. Through the discussions on the "block approach" or the "block development process", the DPEIS has given clear indications of when follow-on NEPA analysis will occur. We agree with this approach. However, while the documents give representative examples of past, current, or proposed locations where proposed activities may occur within each biome, EPA recommends that the EIS discuss the criteria that MDA will use in making future decisions for site-specific locations.

b. The resource areas considered in this analysis are those resources that MDA believes can potentially be affected by implementing the proposed BMDS. EPA agrees that some resource areas are site-specific or local in nature and, therefore, cannot be effectively analyzed in this type of programmatic document and that the potential impacts on these resources are more appropriately discussed in subsequent site-specific documentation tiered from this PEIS. However, EPA recommends that the final document discuss the existence of multiple species habitat conservation planning efforts that are proximate to DoD lands and the potential impacts of debris on marine and aquatic ecosystems.

c. As suggested by CEQ regulations, MDA has taken advantage of the extensive environmental analyses that already exist for many of the existing components of the proposed BMDS by incorporating these materials into the DPEIS by reference. However, some of these documents are greater than 10 years old. The PEIS should confirm the validity of the information in these documents.

2) Perchlorate Comment: Because there have been differing interpretations of the science associated with the impact on human health from low level exposure to perchlorate and in the interest of resolving scientific questions, EPA, the Department of [illegible] artment of Energy, and the National Aeronautics and Space Administration - [illegible] ader Interagency Working Group on Perchlorate led by the Office of S [illegible] ology Policy - have referred scientific issues and EPA's 2002 Draft Health Asses [illegible] rate to the National Academy of Science (NAS) for review. NAS is currently conducting a study to determine the best science and model to use for determining the health impacts and standards for perchlorate. A report on this study is expected to be completed by the end of 2004. EPA recommends that the results of the report be incorporated into the FPEIS.

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We appreciate the opportunity to review this DPEIS. We also look forward to reviewing the FPEIS related to this project. The staff contact for the review is Marthea Rountree and she c [illegible]

Sincerely,

for

Anne Norton Miller
Director
Office of Federal Activities

Enclosure: Summary of Rating Definitions

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SUMMARY OF EPA RATING SYSTEM

Rating the Environmental Impact of the Action

- LO (Lack of Objections) The review has not identified any potential environmental impacts requiring substantive changes to the preferred alternative. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposed action.
- EC (Environmental Concerns) The review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact.
- EO (Environmental Objections) The review has identified significant environmental impacts that should be avoided in order to adequately protect the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). The basis for environmental objections can include situations:
  1. *Where an action might violate or be inconsistent with achievement or maintenance of a national environmental standard;*
  2. *Where the Federal agency violates its own substantive environmental requirements that relate to EPA's areas of jurisdiction or expertise;*
  3. *Where there is a violation of an EPA policy declaration;*
  4. *Where there are no applicable standards or where applicable standards will not be violated but there is potential for significant environmental degradation that could be corrected by project modification or other feasible alternatives; or*
  5. *Where proceeding with the proposed action would set a precedent for future actions that collectively could result in significant environmental impacts.*
- EU (Environmentally Unsatisfactory) The review has identified adverse environmental impacts that are of sufficient magnitude that EPA believes the proposed action must not proceed as proposed. The basis for an environmentally unsatisfactory determination consists of identification of environmentally objectionable impacts as defined above and one or more of the following conditions:
  1. *The potential violation of or inconsistency with a national environmental standard is substantive and/or will occur on a long-term basis;*
  2. *There are no applicable standards but the severity, duration, or geographical scope of the impacts associated with the proposed action warrant special attention; or*
  3. *The potential environmental impacts resulting from the proposed action are of national importance because of the threat to national environmental resources or to environmental policies.*

Adequacy of the Impact Statement

- Category 1 (Adequate) The draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.
- Category 2 (Insufficient Information) The draft EIS does not contain sufficient information to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the proposal. The identified additional information, data, analyses, or discussion should be included in the final EIS.
- Category 3 (Inadequate) The draft EIS does not adequately assess the potentially significant environmental impacts of the proposal, or the reviewer has identified new, reasonably available, alternatives, that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. The identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. This rating indicates EPA's belief that the draft EIS does not meet the purposes of NEPA and/or the Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS.

DC_F0004

To:

Cover Sheet 11/17/04
M.D.A.

To: PEIS Comments
from Public.

5 pages to follow.

Please Call
to Confirm the reception of
these pages. Thank you,

from: V.J. Kennedy

called to confirm receipt of
[illegible]

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11/16/04

Missile Defense Agency BMDS
P.E.I.S. Comments by Public
United States of America

To whom it may Concern or Cares,

My name is Vikki Jo Kennedy. I am a exiled (Since March 2002) resident of Kodiak Island Alaska. I am currently surviving in Ritchie Co. West Virginia.

I miss Kodiak every day + want to go back Someday.

My Comments on the P.E.I.S. are as follows.

I became personally effected by N.M.D. plans when it was announced on July 13th 2001 that Missile Sites were to be installed by N.M.D. at the Kodiak Launch Complex. And that it was Now a Missile Defense Site. NOT just a Simple "Commercial" Rocket Launch Complex as [illegible] it was at first. This "Site" is only 12 Air miles from the town [illegible] Kodiak where over 3/4 of the Islands Population is located. I was devastated by the announcement buried on Pg. 5 of our Local Lil Paper [illegible] for the 5 or 6 years previous to that announcement I was a Supporter of the K.L.C. + A.A.D.C. I was the tour guide to the Site on many tours. Some of which were for big dignitaries + ranking Military personal. future plans were often discussed in my presence. I sometimes questioned some

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of the plans but was told all was OK and to "NOT worry or be concerned..." "They" Knew what to do and all. I went along. I sometimes scoffed at the small group of Kodiak Citizens (who were all very educated + wise) that were Opposed and skeptical of the KLC. They said it was Sinister etc. The

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very first thing to throw-up there red flag was the 23 million dollars the U.S.A.F. gave the A.A.D.C. when the State of Alaska ran Short of funding to complete the State owned K.L.C. they questioned why would the D.O.D. want to put in monies? Well, on July 13th 2001 that all became very apparent to me + many other Kodiak Citizens. I felt So betrayed + used as an Advocate of a program far + beyond what I was told it was to be. I knew I was fooled + Tricked out of my hopefulness that the KLC was A good thing for Kodiak. Now as I sit here writting these Comments 3 years 4 months and 3 days later (But who's Counting - right) I have No Hope this will ever be any good for the Citizens of Kodiak and beyond. I wish it would all just "Go Away" But... We all know that won't happen. Now with the Bush Admin. back in for 4 more Long years God only knows where this will all lead our world too.

So... If you must proceed with this outrageous Program and Launch rockets for military (B.S.) from Kodiak Please Consider my "Wish List" of Concerns + requests OK.

① Take this whole program out to the Aleutian Islands! Thats were all this experimental D.O.D. Stuff should have been put all along. This is all testing. the Kodiak People + Flora + fauna Should not be used this way. Take it West to Adak + Shemya where the D.O.D.

has been set-up doing "there thing" since prior to WW II! Just by the Adak base back from the Native Corp. (It should have never been Sold to them in the first place!) you have all your infrastructure already there too. You Can do lots of experiments out there with lil effects on US citizens if done Correctly.
But.. I'm probably dreaming Big + unrealistic Aye. But... It's better then Crying buckets of tears like I have for the past 3 yrs 4 mos + 3 days + more to come I'm Sure. Just Consider it all please. They Can be a high strike Zone (Target area more then we Can too!)
Since this is a test site for for the G. B. M. D. S. of the M. L. M. D. Please use extream Caution over Safety at All times wherever you do your testing, Please.

① the Planned Rocket Trajectories that go over Kodiak Island + skirt very close to the East Side are just totally [illegible] Native Villages + Bush [illegible] not to mention all the [illegible] Bears!) that live there too.
It is just to damn dangerous to launch over the Island. Period! That Can NOT proceed as planned.

② You have Said in the past year that there are NO longer plans to install Missile Silos on Kodiak. Keep that Plan - No Silos .. Period. You must keep your word true to us citizens. After all its OUR Home + OUR Program too.

③ When you have another Accident like the one on Nov. 09, 2001 where the rocket Blew-up, Tell us the truth right away. Don't lie then tell the truth (forced as it was) 6 mos. later. Maybe if you don't try launching in 40 mph winds with Snow + Rain you might have a better launch window + help the process alot.. just maybe Aye!

④ Dropping Rocket booster Stages Anywhere along the east side (or exterior) of Kodiak Island is totally unacceptable! It is all Critical habitat area for the endangered Steller Sea Lions. There are numerous haul-outs + rookeries all along the Coast of the Kodiak Archipelago. We Commercial fishermen have Severly Shut down from fishing near any of these places So.. You Can't disturb them either! If you kill any off We get the blame, and we will be Shut Completly down from fishing! Please Consider our fate to make a Living OK.

⑤ You do not need to let the AAD[illegible] -up any-more land to use for this progr[illegible] additional 14,000 Acres is our Only area on the Kodiak Road System we (the Citizens) have that is open For Public Use. All the Other land is Private (Native Corps) And 3/4 of the Island is in the Kodiak Island National Wildlife Refuge. Please Do NOT take Control of these lands. No more Land to USE. (the 3,800 Acres you

use now is enough. No more OK. Please.

⑥ Keep it Clean wherever you go to put this all in. Clean up all your toxic Wastes + Garbages. Kodiak Island is one of the most Pristine places left on this planet.. Please Keep it that way. Please.
OUR Close Ocean Waters Are Our Living they must be kept Clean + respected! Rockets + Missiles debrie and fish - just don't Mix! And Last but Not Least ... just be real damn Careful out there. I Love That Island and want to keep it Safe. Please Be Careful.

Thank you for this opportunity to express my opinions. Maybe they will be Considered? I only have true Concerns for my Home + my Country and Planet.

Sincerely,
Vikki Jo Kennedy

Vikki Jo Kennedy

1 of 7

Missile Defense Agency

Nov 17, 2004

Comments on PEIS submitted on behalf of LAWS, by Philip A. Fleming. 202-[illegible]
Please acknowledge receipt.
Thank you

Philip Fleming

[illegible]

LAWYERS ALLIANCE FOR WORLD SECURITY (LAWS)

COMMENTS ON THE BALLISTIC MISSILE DEFENSE SYSTEM DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Submitted to the Department of Defense's Missile Defense Agency

By Philip A. Fleming, on behalf of LAWS

The draft Ballistic Missile Defense System (BMDS) Programmatic Environmental Impact Statement (PEIS), dated September 1, 2004, is required by NEPA to provide an objective and through assessment of the effects various missile defense architectures would have on the environment. LAWS submits that it fails in several respects to do this. Instead, it has been developed, organized and shaped to give credibility to the Bush Administration's continued assertions that the only way the United States can be protected from an ICBM attack is with a heavily tiered missile defense system. Consequently, the draft PEIS either does not discuss or dismisses real concerns about harmful negative consequences from developing such a system. In view of this fatal flaw, the draft PEIS is essentially an inadequate attempt to justify decisions that have already been made.

LAWS had assumed, when it submitted comments on October 14, 2004 at the public hearing in Crystal City, Virginia, that some of the PEIS deficiencies could be rem[illegible] by further analysis and substantive changes to the draft. However, [illegible] further study and analysis of the draft PEIS, LAWS has reluctantly concluded that even this flawed document comes so late in BMDS development and testing that it is largely irrelevant. For example, Section 1.2 shows that environmental analyses have already been completed for most components, the notable exceptions being the Aegis BMD and space-based weapons. As we understand it, development and testing of most components are well underway and decisions about initial deployment of GBI's and Aegis BMD ships have been made.

Morever, the spiral development process, which is described on page ES-7 of the PEIS, allows MDA to "consider deployment of a missile defense system that has no specified final architecture and no set of operational requirements." Such a process is apparently intended to preclude any meaningful assessment, and thus far it has

succeeded brilliantly, to the detriment of the public interest, the national defense of the United States, and in frustration of the purpose of requiring careful NEPA analysis of major federal actions.

Another major deficiency of the draft PEIS is that it lacks a genuine "No Action Alternative", even though NEPA explicitly requires that such an alternative serve as a baseline against which to compare the environmental impacts of the other alternatives. LAWS is compelled to conclude that the MDA simply did not consider a "No Action Alternative" seriously. For example, the MDA asserts on page 2-67 that "it would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress." Further, footnote 19 on page 1-6 quotes the part of the 1999 Missile Defense Act which declares the policy "to deploy as soon as is technologically possible an effective NMD system." The PEIS also notes on page 1-6 that President Clinton decided in September 2000 not to authorize deployment of an NMD system for reasons including technical uncertainties and unsuccessful flight tests. The PEIS does not concede that even if the technology worked perfectly, the systems being deployed are vulnerable to countermeasures that are easier to build than the long-range missile on which they would be placed, another concern that contributed to President Clinton's decision not to deploy the system the Bush Administration is now rushing to deploy.

In addition, two GAO reports in 2003 and a Union of Concerned Scientists report titled "Technical Realities" released in May, 2004 raise further serious questions about the readiness for deployment of the current NMD components. It seems clear to LAWS that a properly-articulated "No Action Alternative" –which was essentially U.S. policy until 2002 – is vastly preferable until the MDA can persuasively demonstrate that an "effective" NMD is "technologically possible." Recent test results underscore thi[illegible]. The most recent NMD intercept attempt failed on Decemoer 11, 2002, six days before President Bush announced that the U.S. would deploy an ini[illegible] system. This rush to deploy an untested system flies in the f[illegible] the test results so far, and suggests that the independent anal[illegible] that state that it is at least questionable whether an effective NMD system is possible, have been ignored. The policy stakes are far too high, and the $10 billion annual expenditures far too great, to proceed with this global gamble.

LAWS submits that this extraordinary emphasis on missile defense represents misplaced priorities. As President Bush agreed in the pre-election debates with Senator Kerry, the Administration's top non-proliferation priority should be combating the threat of

nuclear terrorism by increasing its programs to keep nuclear warheads and fissile material out of the hands of terrorists. The Bush Administration, however, is giving this problem a fraction of the attention and a fraction of the funding being given to missile defense. Since the technology needed for an effective missile defense system still doesn't exist, LAWS believes that the missile defense system being rushed into deployment in Alaska and at Vandenberg AFB in California is not relevant to the war on terrorism.

I. THE PEIS IS FATALLY FLAWED BECAUSE IT DOES NOT COMPLY WITH NEPA

The width of the range of alternatives that an agency must identify and analyze in an EIS is based on the purpose of, and need for, the agency action. (See 40 C.F.R. Sec. 1502.13, 1502.14.) Therefore, a narrow project purpose and need requires a fewer number of reasonable alternatives than a broad project purpose and need, which may have an infinite number of alternatives. (See NRDC v. Morton, 458 F.2d 827, 835; D.C. Cir. 1972) In addition, the purpose of the proposed action also influences how the "no action" alternative should be presented. When the purpose is narrow, encompassing distinct federal action on a new project, the "no action" alternative must address the environmental effects of the action not going forward, including the effects of any probable outcomes that will occur without the project. (Forty Most Asked Questions, 46 F.R. 18026, at Answer 3.) Alternatively, when the project is broad, encompassing the next phase of federal action in a continuing project, as here, the "no action" alternative must consider the effects of "no change" from the present course of action. (See also American Rivers v. Federal Energy Regulatory Commission, 201 F. 3d 1186, 1201; 9th Cir. 1999).

Here, MDA's interpretation of the proposed project purpose and need is internally inconsistent - in one case narrow, in the other broad. The MDA chooses its alternatives based on the narrow purpose of developing an integrated, multi-layered BMDS while its "no action" alternative allowing for continued research and testing of a non-integrated BMDS, implying that the project supports the general purpose of protecting the United States from foreign missile attacks through any means necessary. (PEIS at pp. 1-1 to 1-8, describing the general history of the government's ongoing development of ballistic missile defense programs.) Consequently, in the PEIS, the MDA sets out two internally contradictory positions On the one hand, the MDA narrows the purpose of the proposed action, and thus the spectrum of alternatives to be considered, to the creation of a singular, integrated, multi-layered BMDS that is not part of a continuing program to protect the U.S. from ballistic missile attacks. On the other

hand, the agency relies on the long history of the U.S.'s missile defense actions to frame its "no action" alternative as a "no change" in an ongoing project with the broad purpose of protecting the U.S. from ballistic missile attacks. On either ground, the PEIS fails to meet the NEPA test – that it interprets its purpose too narrowly in order to develop a very narrow spectrum of alternatives, or that it interprets the purpose too broadly in order to assert a "no action" alternative that allows for continuing, non-integrated action – but not both.

In determining whether the alternatives analyzed within an EIS are adequate, courts have determined that the range of alternatives an agency must consider, although not "self-defining," is 'bounded by some notion of feasibility." (Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 551 (1978). Accordingly, the alternatives examined by an agency must include only those that are reasonable and feasible – i.e., that are "meaningly possible". However, reasonableness is determined through a fact-specific examination of each proposed project because "what constitutes a reasonable range of alternatives depends upon the nature of the proposal and the facts in each case.

A flaw in the PEIS is that the range of alternatives considered by the MDA is not adequate, because the agency unreasonably narrowed the range of alternatives to be examined by narrowly interpreting the purpose of the proposed action as the development of a multi-layered ballistic missile defense system. While courts typically afford agencies some discretion in defining the purpose and need of a proposed project, that discretion is limited by the reasonableness of the agency-defined purpose and need. It is also clear that an agency may not characterize its proposed action purpose so narrowly as to avoid its NEPA obligations. (See Friends of Southeast's Future v. Morrison, 153 F.3d 1059, 1066; 9th Cir. 1998, and Simmons v. US Army Corps of Engineers, 120 F.3d 664, 669-670; 7th Cir. 1997. It seems to LAWS that that is exactly what the MDA has done here. We doubt that a reviewing court would condone it, or find that when an agency varies its interpretation in order to avoid its NEPA responsibilities, the PEIS can be found to meet the NEPA standard.

In this connection, the spectrum of alternatives to be considered must be broader than those considered by the MDA. (See Morton, 458 F.2d at 837) Accordingly, a court could find that consistent with its obligations under NEPA that the MDA should have considered as an alternative the Theater Missile Defense System which has already been developed and, therefore, would not require excessive resources to implement. The MDA should also have considered, and included in the PEIS, alternatives that offer a less than complete solution to the problem. To the extent that it hasn't, the MDA should also have analyzed the BMDS platforms for each component and/or defense environment separately.

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Other options include an analysis of alternatives that include both weapon and non-weapon components; such as integration of land and sea-based platforms only with increased diplom[illegible] efforts. As the Court said in Morton, an agency cannot
restrict its alternatives because it is not part of its jurisdiction. Since the BMDS is part of a broader purpose of protecting the U.S., the MDA should have fulfilled its NEPA obligations by analyzing a much broader spectrum of alternatives to achieve this purpose.

As pointed out above, instead of crafting the PEIS to justify decisions that have already been made, the MDA should have included a genuine "No Action Alternative", as required under NEPA. Such an alternative could have been "Cancel Development of Ballistic Missile Defense Capabilities" because it does not meet the purpose of or need for the proposed action. It is acceptable under NEPA to evaluate and reject a No Action Alternative because it doesn't meet the purpose of a program, but the environmental impacts of that alternative must be considered as a baseline against which to compare the environmental impacts of the other alternatives. This the MDA has not done. For example, the PEIS projects 515 BMDS launches over the next decade. The sheer volume of this many launches dwarfs the number of projected government and commercial launches over the same period, and the volume of solid rocket propellant involved will generate large quantities of hydrogen chloride, which reacts in the atmosphere to create acid rain. The PEIS should provide more detailed estimates of perchlorate waste likely to be generated by system development, testing, deployment, maintenance, and decommissioning, and acknowldge the potential impacts of such exposure.

II The draft PEIS fails to analyze what would be required to develop a space-based test bed, dismissing the suggestion as "too speculative." But that is precisely what the PEIS is supposed to – to examine the environmental effects of the proposed action. Accordingly, the draft PEIS is flawed for not looking at the effect of space-based interceptors in lieu of terrestrial-based ones - it simply suggests that future studies may be required. This dismissive attitude toward NEPA would not survive judicial scrutmy. Nor would the back-of-the-envelope dismissal of debris, orbital and otherwise. Frequently the PEIS posits that such debris poses a small risk, and downgrades the threat – which would come as a great surprise to our partners in the International Space Station. LAWS' adopts and incorporates here by reference the compelling exposition of the dangers from space debris set out in the October 18, 2004 testimony of Theresa Hitchens, Vice President and Director of Space Security of the Center for Defense Information. This is a dramatically fatal flaw in the PEIS; one that ought not be swept under the NEPA rug.

III Some additional detailed comments and suggestions, in addition

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to those raised by others who testified and submitted statements at the four quasi-hearings the MDA held in October, include:

(1) In order to evaluate the risks from launch failures, the PEIS should give qualitative information on the reliabilities of the boosters to be used to launch targets for BMDS tests.
(2) The draft PEIS contains no discussion of INF Treaty restrictions on long-range air-launched and sea-launched targets, or START Treaty restrictions on sea-launched targets. Accordingly, the PEIS should examine in detail treaty compliance of various BMDS tests.
(3) The PEIS discussion of cumulative impacts in Sec. 4.1.4 and Appendix I contains no details about the location, schedule, and specific missiles to be used for the estimated 515 launches from 2004 to 2014. They are essential.
(4) The PEIS should indicate when an environmental analysis of the Aegis BMD system will be done. The earlier EIS relied upon at page D-15 is contains misleading information.
(5) The PEIS should review the testing of future laser weapons systems and specify testing plans for other high-power laser laser weapons and other energy-directed weapons. It does not.
(6) If interceptors armed with nuclear weapons are being considered or missile defenses, as some reports indicate, the PEIS should indicate what research and development work is being planned for such weapons as part of the Advanced Systems in Appendix F.

Please acknowledge that you have received these comments.

Philip A. Fleming

DC_F0006

Program Planning & Integration
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
13155 East West Highway
SSMC-3
Silver Spring, MD 20910

Assistant Administrator

Acting Director, Strategic Planning Office
James H. Butler –

TO:	MDA BMDS PEIS c/o ICF CONSULTING	**FROM:** **Tel.:**	RAMONA SCHREIBER
FAX:	877-851-5451	**Number of Pages** (including cover sheet)	4

MESSAGE:

NOAA COMMENTS ON BMDS PEIS

DC_F0006

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

NOV 17 2004

MDA BMDS PEIS
C/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Dear Project Leader:

Thank you for the opportunity to review the Missile Defense Agency Ballistic Missile Defense System Programmatic Environmental Impact Statement. On behalf of the National Oceanic and Atmospheric Administration (NOAA), provided here are comments developed by NOAA's National Marine Fisheries Service (NOAA Fisheries). NOAA's responsibilities include conservation of resources under the Magnuson-Stevens Act Essential Fish Habitat provisions, Endangered Species Act, and Marine Mammal Conservation Act.

Should you have questions and when you are ready to consult further with NOAA regarding requirements under the above statutes, please contact the NOAA Fisheries Southwest Regional Office at 562-980-4000.

Sincerely,

For Ramona Schreiber
Susan A. Kennedy
Acting NEPA Coordinator

Attachment

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NOAA Fisheries Southwest Region's comments for inclusion in a NOAA response for the Missile Defense Agency's proposed Ballistic Missile Defense System

The Southwest Region, National Marine Fisheries Service (SWR) has reviewed the September 1, 2004, draft Programmatic Environmental Impact Statement (draft PEIS) for the Missile Defense Agency's proposed Ballistic Missile Defense System (BMDS). The purpose of the proposed action is for the Missile Defense Agency to incrementally develop and field a BMDS that layers defenses to intercept ballistic missiles of all ranges in all phases of flight. The BMDS is proposed to be a layered system of defensive weapons that have the potential to impact particular trust resources of NOAA during activities associated with the development, testing, deployment, and planning for decommissioning of the BMDS. This memo letter the SWR's comments on the proposed action under purview of the Essential Fish Habitat (EFH) provisions in the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S. C. 1855, *et. seq.*), and protected resource provisions in the Marine Mammal Protection Act (16 U.S.C. 1361 *et. seq.*), and the Endangered Species Act (16 U.S.C. 1531 *et. seq.*).

Essential Fish Habitat Conservation Recommendations

Pursuant to 16 U.S.C. § 1855(b)(2) of the Magnuson-Stevens Act, Federal agencies are required to consult with the Secretary of Commerce (delegated to NOAA Fisheries) with respect to "any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any essential fish habitat identified under this Act." In addition, the Magnuson-Stevens Act also requires the Secretary of Commerce recommend to the federal action agency particular measures that can be taken by such agency to conserve fish habitat (16 U.S.C. § 1855(b)(4)(A).

This consultation involves the EFH of anadromous and marine species managed by the Pacific Regional Fishery Management Councils within the Exclusive Economic Zone of the United States for the Pacific Salmon Fishery Management Plan (FMP), the Coastal Pelagic Species FMP, the Pacific Groundfish FMP, and the Highly Migratory Species FMP. These species utilize various habitats that include riverine, estuarine, and marine systems and these habitats may be adversely affected by some of the activities associated with the development, testing, deployment and planning for decommissioning of the BMDS. Primarily, the agency is concerned about potential release of hazardous materials (e.g., chemicals, propellants, propellant by-products, launch emissions) that potentially could be released directly and indirectly to the habitat types listed above during various phases of the BMDS. In order to minimize these potential impacts, the SWR advises the following:

1. NOAA Fisheries recommends that the Missile Defense Agency be responsible for handling and disposing of all hazardous materials or hazardous wastes in all phases of the proposed action in accordance with applicable Federal, state, and local laws, utilizing best management practices at all life cycle activities of the proposed action and through appropriate project planning and design measures including appropriate spill prevention, control and contingency plans (e.g., Oil Discharge Prevention and Contingency Plan, Storm Water Pollution Prevention Plan) for each site.

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Endangered Species Act

Based on the information provided in the draft PEIS, NOAA Fisheries recommends that the Missile Defense Agency consult with the appropriate NOAA Fisheries Regional Office to determine if listed species under the Endangered Species Act (ESA) of 1973 as amended (16.U.S.C. 1531 *et. seq.*) may be affected by the proposed project. If it is determined that this project may affect a listed or proposed species, the Missile Defense Agency should request initiation of consultation with NOAA Fisheries pursuant to section 7 of the ESA.

Marine Mammal Protection Act

Whales, dolphins, seals, and sea lions are protected under the Marine Mammal Protection Act (MMPA). Under the MMPA, "take" of a small number of marine mammals is permitted by NOAA Fisheries under an Incidental Harassment Authorization (IHA) when the specified activity is incidental, but not intentional. "Take" is defined as harassing, hunting, capturing, or killing, or attempting to harass, hunt, capture, or kill any marine mammal. "Harassment" is defined as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal in the wild, or has the potential to disturb a marine mammal in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. Based on the information included in the draft PEIS, the proposed project may cause take of marine mammals under the jurisdiction of NOAA Fisheries. NOAA Fisheries recommends that the Missile Defense Agency consult with the appropriate NOAA Fisheries Regional Office when conducting the site-specific analyses for potential impacts to marine mammals.

DC_PHW0008

Women's International League for Peace and Freedom
United States Section
1213 Race Street, Philadelphia PA 19107-1691
(215) 563-7110 • Fax: (215) 563-5527 • Email: wilpf@wilpf.org
Website: www.wilpf.org

October 19, 2004

Missile Defense Agency BMDS PEIS
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Dear Friends,

Women's International League for Peace and Freedom (WILPF) submits the following initial comment on the current draft Programmatic Environmental Impact Statement of the Missile Defense Agency.

WILPF is a ninety year old non-governmental organization that has worked tirelessly since its inception to put an end to war. WILPF has supported the development of international institutions and international law, and non-violent methods of conflict resolution that together can facilitate the co-existence of diverse nations and peoples on this planet.

We hope the comments of ourselves, and of others who oppose the militarization of space, will be considered seriously, and that both environmental concerns and concerns for the future of our human race will lead to suspension of this ill-advised and destabilizing missile defense program.

The MDA draft PEIS seeks to answer to detrimental environmental effects of three alternative development plans for Ballistic Missile Defense. We have found the answers disturbingly incomplete. We have also carefully considered all three alternatives presented and have concluded that it would be dangerous – and indeed disastrous -- for the future of our nation to proceed with any of them. It is impossible to comment on all the details in the 701 page document in this short space, but we expect to submit several supplementary comment papers on a few of the many issues of deep concern to us.

First, we are convinced that Alternative 2, which includes development of space based interceptors, is completely unacceptable. We will submit additional comments on both the issue of debris from experiments with space based weapons and on the development of laser weapons. We have other concerns re Alternative 2 that you will perhaps argue are beyond the scope of this PEIS, but that makes them no less important. One is the creation of orbiting debris in space which will remain there

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as a threat to future space exploration. The second of these is that space based laser interceptors will be a first step toward the more ambitious program of space weaponization already developed by the Pentagon and the Space Command, and presented in detail in the November, 2003 *U.S. Air Force Transformation Flight Plan*. This is a direction in which no civilized nation should proceed!

We believe that Alternative 1, which does not include space based weapons, and Alternative 3, which is unclear on this point, are also unacceptable, even from a solely environmental viewpoint. We are concerned about the adverse effects in all of the resource areas discussed in the MDA PEIS including hazardous waste, legal restraints, decommissioning of the weapons systems, destruction of the ozone layer, global warming and rocket fuel pollution of our water and river systems. We are preparing supplemental comments on at least some of these concerns.

We also wonder why this expensive and almost certainly unachievable missile defense program has been developed in the first place. It does not answer to probable threats to our national security in the present or in the coming decade. It will do nothing to prevent terrorist attacks, and there is now no hostile country or group with the capability of firing inter-continental ballistic missiles at the United States. Missile defense seems rather to be preparation for future confrontation with the only two countries really capable of threatening our current military domination or challenging us with nuclear attack. Neither of them – China or Russia – is currently an enemy, but this aggressive program may well push them into organizing allies and forces against our own threat of global – and planetary -- domination.

With this in mind, we will submit an additional comment on what we consider to be the only feasible alternative approach to protection of our land and peoples from intercontinental ballistic missiles, from the ravages of nuclear, biological or chemical warfare – or, indeed, from either attacks by small bands of terrorists or from what we have come to call "conventional warfare" (e.g. our own recent "shock and awe" attack on Baghdad).

This Alternative 4 would include a return to the United Nations disarmament treaty process (which the current Administration is regrettably blocking), and assumption of a lead role in the continual development of enforceable and universally applied international law consistent with both the UN Charter and the Universal Declaration of Human Rights. The United States would re-enter that process as the most powerful and most militarized nation in the world and would have no substantial military rivals. This is a rare and critical moment in history and the choice is ours: the United States can lead the way toward a world freed from war with sustainable development and human rights for all – or this nation can drag the human race backward with it into a world ruled by war, military domination and the threat (or use) of weapons more powerful than any known before.

For us in the WILPF there is no question about which route is preferable. We are convinced that continuing with any of these three BMD programs will make the step-by-step process of nuclear disarmament impossible, make war on earth and in space inevitable, and seriously threaten human existence and the entire fragile web of life on our unique and precious planet. We urge all those in the Pentagon, the Missile Defense Agency and in the aerospace corporations to join us in choosing life over death and step-by-step peace building over further destruction of this planet and its fragile web of life.

Sincerely,

Sandy Silver

Sandy Silver, President
United States Section

Missile Defense Agency
BMDS PEIS
c/o ICF Consulting
1300 Lee Highway
Fairfax, Va 22031

Gentlemen:

I urge that the employment of the untested missile defense system be halted until realistic testing can be completed.

As you know, the Missile Defense Agency is required by law to prepare a Programmatic Environmental Impact Statement to assess the missile defense system's environmental consequences, including national security concerns. The Bush Administration's intention of deploying the system without regard to the PEIS process, and without conducting realistic tests will result in its being ineffective against real attack.

According to expert analysis by the Union of Concerned Scientists, such tests are necessary to determine whether the system will work. It states that the system should be tested at full operational speeds, using components identical to those in the final version of the system, and should be tested against countermeasures such as decoys that could fool or overwhelm the defense. No tests have yet been conducted under these conditions.

In addition, the ADministration's missile defense system lacks a key component: the X-band radar intended to track incoming warheads and help guide the interceptors to their targets.

The present head of the Pentagon's testing office wrote in January 2004 that there were not enough test data to assess the effectiveness of the system planned for deployment. His predecessor recently wrote that the "system to be deployed in 2004 will not have the major elements needed to be operationally effective and would appear to be just for show." The statements of both heads of the testing office were according to reliable information obtained by the Union of Concerned Scientists.

The untested missile defense system has the potential to undermine space security, and is nothing more than a wasteful, and potentially dangerous, political charade, according to the Union of Concerned Scientists.

I respectfully request that you inform me as to what steps you intend to take in this matter in order that I may inform the head office of the Union of Concerned Scientists in Cambridge, Massachusetts.

Sincerely,

Louis S. Campbell
Member, Union of Concerned Scientists

Women's International League for Peace and Freedom

November 8, 2004

MDA BMDS PEIS
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Re. NO ACTION Alternative is the only viable option

Dear Sir/Ma'am

In reviewing the three alternatives regarding a Draft Programmatic Environmental Impact Statement for the proposed Ballistic Missile Defense System, we find both Alternative 1 and Alternative 2 to be unacceptable in that if either were implemented, either would generate a new arms race in space, resulting in unimaginable environmental damage, even just from testing of its components, and possible accidents or errors

The NO ACTION alternative is the only acceptable option, but one in which there would be NO FURTHER RESEARCH OR DEVELOPMENT of "Missile Defense" systems or "Space Based Weapons."

The proposed Ballistic Missile Defense System (BMDS) would have unacceptable toxic and damaging environmental impacts at all stages of the project, particularly testing and deployment. Environmental consequences, if the system is ever used, could be severe in locations where impact would occur, and possibly impact neutral countries that were not a part of the nations which were at conflict.

In our view, our government has not made a convincing case that the BMDS is necessary or desirable. We firmly believe there is no credible enemy missile threat that would justify expending the huge cost (scarce materials, energy supplies, brain power, etc.) to create a complex system that in itself is causing environmental damage, and which diverts limited resources away from desperately needed infrastructure building or repair, or provision for a variety of human needs. U.S. National Security will be enhanced if those funds are directed to environmental cleanup, a safe energy system that would disconnect our economy from oil dependency, a universal health care plan, public education, jobs, affordable housing, public transportation and the like

So our basic conclusion would be that a NO ACTION alternative, that
NO ACTION, cutting off all funding for any further development of B ems of it.

The recent election has given this administration a vote of confidence for its "moral leadership." Those who plan military activities should take this moral mandate to heart, and plan a truly DEFENSIVE military program.

The BMDS is part of a political mindset whose ultimate goal is U.S. supremacy by military might. This is not a moral position or policy. WILPF and the majority of U.S. citizens strongly oppose this goal. The MORAL position would be to have policies that generate cooperation and

co-existence of all peoples. Such a policy of co-existence and cooperation would not destroy our environment by adding further to the ozone destruction with unneeded and resource-wasteful launches (test or actual firings) of a BMDS

The BMDS for which these comments are solicited would create a terrible arms race in space. Other countries may not be as careful as the U.S. in trying not to pollute the environment

Further testing and deployment of this system, whether U.S. or other countries that will be forced to compete with the U.S., would

1) cause further releases of toxic rocket exhaust that is already damaging the ozone. Present rocket launches must be reduced because of this perchlorate and other toxic releases

2) pave the way for use of nuclear reactors in space, a very dangerous precedent, with potentially catastrophic consequences. There have already been accidents of space vehicles whose instruments were powered by RTG's, spreading radiation in our atmosphere and also where crashes to earth have polluted the soil. The same risks, only more severe, are inherent in launching nuclear reactors in space. This is an unacceptable risk

3) greatly expand the amount of space debris, causing additional hazards for existing communications satellites and interference for future scientific space exploration

We strongly recommend that a United Nations oversight board be constituted that would review all space related activity... worldwide... with advisory AND enforcement capacity. Regulations must be set to curb extravagant uses of space, risky and unwise launches, reduce duplication of space exploration, and to encourage information sharing between countries. This oversight board could help minimize environmental pollution. Knowledge learned could be shared, to reduce the stress on the environment

In summary, we strongly advocate a No Action Alternative, and further request that the PEIS should be re-written to take into consideration the issues raised in this comment

These comments are submitted on behalf of the members of the Tucson Branch of the Women's International League for Peace and Freedom

Sincerely,

Patricia Birnie

Patricia Birnie, Legislative Chair

To: Missile Defense Agency November 12, 2004

Concerning: Environmental impact of Space based Missile Defense Systems

I am writing to express my concerns about the environmental impact of the Ballistic Missile Defense System.

At this time we are discovering just how polluting our use of fossil fuels is to our environment: creating global warming with it's multitude of known and unknown effects, and directly affecting the health of humans, as shown in the ever increasing numbers of people with asthma, especially in children.

Now our government plans to deploy even more satellites and space weapons, with more rocket fuel polluting our upper atmosphere. Even if we didn't use the space weapons (which is unlikely), we will change the earth's atmosphere in ways we won't know until it's too late, just by putting it in place and testing. This will affect not only our own country and people, but the whole world.

The cost of this unproven system will deny citizens their needs on earth, including measures to clean up and protect the environment. The expense of this system far outweighs it's (lack of) necessity. If we need money for security, the money should be spent on defense against the new reality of terrorism, which uses underground, low technology violence. Expensive space based defense answers the new violence with cold war thinking and will not protect us. Rather, the use of space based weapons would ultimately be detrimental to all through degradation of the atmosphere and our planet. Such degradation could also make scientific space exploration more difficult because of space "junk".

For all these reasons, I support ending all work on the Missile Defense system. None of the alternatives presented in your Draft Programmatic Environmental Impact Statement includes ending the program. Therefore, I call on you to rewrite and resubmit the PEIS for public comment, including another alternative: ending the Missile Defense System.

Nancy L. Lynch

Nancy L. Lynch

This letter overrides my letter of Oct 19, 2004

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November 15, 2004

Missile Defense Agency BMDS PEIS
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The No-Action Alternative

Dear Friends,

This is the second comment submitted by Women's International League for Peace and Freedom on the Missile Defense Agency draft *Programmatic Environmental Impact Statement.* This comment is submitted by the WILPF DISARM: Dismantle the War Economy committee. We are proposing a different text for Alternative 3, or it can be considered as Alternative 4.

The existing text for Alternative 3 is not a NO ACTION alternative. The MDA itself rejects it as an inadequate version of the first two alternatives presented. The present Alternative 3 would include all of the components in Alternatives 1 and 2 and apparently also space-based weapons, but MDA would develop them individually rather than as an integrated system.

WILPF believes a genuine alternative should be presented against which to compare the other two. A summary of proposed Alternative 4 is given here, followed by comments on the environmental impact and wider implications of this approach.

Alternative 4 (revised Alternative 3)

1) Beginning in January 2005 **the current Ballistic Missile Defense Program (BMD) would be suspended immediately and in entirety**, or a moratorium on deployment, research and development would be declared while a thorough investigation of the program occurs.

Congress, the Administration, auditors, scientists, aerospace engineers and the general public would participate in a thorough reconsideration of the costs, workability and desirability of this program in all its aspects.

2) The President of the United States would at the same time announce his intent to **return to the United Nations disarmament treaty process** which the United States has been blocking during the past four years. Of first importance would be reaffirmation of the *Nuclear Weapons Non-Proliferation Treaty* (NPT) and of our intent to keep the 13 promises made at the close of the NPT Treaty Review in 2000.

In the past four years the present Administration has broken all but two of these promises. Continued pursuit of the BMD treaty will almost certainly result in the collapse of the NPT and in further nuclear weapons proliferation. This would be a tragic loss. The NPT has over the past 34 years resulted in the reduction of nations with nuclear weapons. Seventeen nations have given up their nuclear weapons. By 2002, with Cuba's accession, 188 nations were subject to the NPT's provisions. Only Israel, India and Pakistan, all with nuclear weapons programs, remained outside the treaty. In January 2003 the Democratic Republic of North Korea withdrew from the treaty, arguably in reaction to new, more aggressive U.S. nuclear policies including the BMD program, and our failure to help it solve its energy problems. **The aggressive pursuit of Missile Defense during the past four years and initial deployment, though its components are at present unworkable, is not consistent with support of the NPT.**

The President would, as a matter of greatest urgency, show U.S. support of the NPT in concrete ways. An announcement of the **dismantling of the BMD program** or a moratorium on its development would be a significant first step. A second would be to declare an **end to research and development of new classes of nuclear weapons,** in violation of Article Six of the NPT. Continuance with the BMD program almost certainly ensures a new nuclear arms race, and new era of either cold or hot war.

3) The President would at the same time work with our allies and the United Nations to **bring India, Pakistan, Israel and North Korea into the NPT.** The U.S. would support vigorous international inspections of all known and suspected nuclear weapons programs, including its own, in both nuclear and non-nuclear countries. The U.S. would also assist in the development and application of more adequate treaty enforcement mechanisms. The best alternative to the environmentally unfriendly Missile Defense, to a new nuclear arms race, and to the threat of global war is to move step-by-step toward nuclear weapons abolition as already agreed by the U.S. under the NPT.

4) The President would at the same time **declare an end to the Pre-emptive War Doctrine** put forth in the Nuclear Posture Review and the National Security Strategy, both issued in 2002. This doctrine, coupled with the development of BMD, is viewed as threatening by most non-nuclear nations and by some of the current nuclear weapons powers.

5) The President would at the same time declare the United States' intent to participate in good faith in all other treaties relevant to the control and eventual abolition of nuclear weapons.

Immediate steps would include reaffirmation of the intent to **ratify the Comprehensive Nuclear Test Ban Treaty (CTBT)** which the present Administration has declared against U.S. national interests, even though it was signed with intent to ratify by a previous President. The President should also announce a complete moratorium on preparations for nuclear weapons testing while pushing for Senate ratification of the CTBT. The U.S. should support the new treaty on fissile materials which it has recently blocked after years of work towards it. Many additional steps could be considered and undertaken.

6) The President would at the same time reaffirm the U.S.'s continued support for other disarmament treaties previously ratified which we have been blocking or undermining during the past four years. This would include enforcement of **the 1967 Treaty on the Peaceful Uses of Space** and cooperation with Canada and other nations to expand it to include a ban on weaponization of space and rules for regulation of corporate development in space.

This reaffirmation would include **the Bio-weapons treaty,** for which the current Administration has rejected international monitoring and inspection. It would include the treaty on Chemical weapons with which there is currently evidence of U.S. compliance. Another argument put forth by the MDA for the BMD is the need to counter missiles carrying biological or chemical warfare agents. A better defense against these weapons of mass destruction would be the dismantling of all chemical and bio-weapons programs, and international monitoring and inspection to ensure continuing compliance with the existing Bio-weapons treaty. In addition, the United States should again contribute to development of international controls on, and eventual elimination of, inter-continental ballistic missiles.

7) The President would, at the same time or immediately after taking the above urgent steps, **reaffirm the entire UN treaty process** designed to promote sustainable economic and social development, human rights and democracy on a global scale. The United States should be a leader in the ratification of treaties ensuring human rights and sustainable development, rather than one of the laggards. Progress in these areas will remove many of the factors contributing to the non-state violence employed by relatively poorly armed rebels against powerful governments or formidable military forces which they perceive to be exploiting and/or oppressing them and their ethnic, religious or ideological groups.

Environmental impact: The detrimental environmental effects of this approach will be far less than those resulting from testing or utilizing the integrated Missile Defense System as outlined in Alternatives One, Two or Three. If the BMD system is suspended, the major detrimental effects would occur in the dismantling process. Even this process, however, would have far less impact than would dismantling the system after three or more decades of development. It would also have far less detrimental environmental impact than if BMD development triggers a new nuclear arms race or results in the actual use of nuclear, biological or chemical weapons. Indeed, laying down the BMD program would release funds and scientific expertise that could be turned to resolving he other great environmental problems now threatening the planet and its peoples.

Proponents of Ballistic Missile Defense should not be concerned that dismantling the BMD system would leave the United States more vulnerable to attack. The United States would be re-entering the United Nations treaty process in a position of unsurpassed military strength. The U.S. already possesses the most powerful military system in the history of the world, arguably more powerful than those of all other nation states combined. If a strong military gives security, then the United States should be the most secure nation on earth.

When the United States begins to lead the way in the UN disarmament treaty process it will not be engaging in unilateral disarmament, but rather joining other nations in a step-by-step

process away from the horrors of war. The U.S. would not re-enter the treaty process in any greater danger than it can expect during the next decade while seeking to develop a Ballistic Missile Defense system. For that system – even if it eventually "works"--does nothing to protect against non-state violence, and the U.S. has no enemies at present among the nations capable of striking its territories with ICBMs. The continued development of this exorbitantly expensive BMD system that may never work raises tensions, creates enemies and makes both nuclear and conventional war on a global scale more, rather than less, likely to occur.

The United States would not put itself in any greater danger than at present, but would shift emphasis, choosing to work for the continuance of human life on earth, with liberty and justice for all, rather than blatantly risking humanity's final destruction in its search for global and planetary domination. There would be many challenges and difficulties along the way, but the choice is between the way of life and the way of death and destruction.

Let us choose the way of life.

In peace,
Ellen Barfield
Ellen Barfield, co-Chair
Carol Urner
Carol Urner, co-Chair

DISARM: Dismantle the War Economy Campaign
U.S Section, Women's International League for Peace and Freedom

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November 15, 2004

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Space-Based Interceptors

Dear Friends,

This is the third comment submitted by Women's International League for Peace and Freedom (WILPF) to the Missile Defense Agency regarding its draft Programmatic Environmental Impact Statement (PEIS). This comment is submitted by the WILPF *DISARM: Dismantle the War Economy Campaign.*

We are commenting briefly on the unacceptability, from an environmental standpoint, of space-based interceptors as proposed in both ALTERNATIVE 2 and ALTERNATIVE 3 (the so called NO ACTION ALTERNATIVE) in the draft PEIS. We see serious environmental threats from orbital debris, from development and testing of laser and kinetic kill weapons, from the possible use of nuclear power in space, and from the further development of weapons in space technology that can also be used against satellites and targets on earth.

Orbital debris: Testing and deployment of space-based interceptors can significantly increase space debris, endangering other objects in space, in the air and on land. We agree with the commentators from the Center for Defense Information that the PEIS does not answer sufficiently to these problems and dangers. We suspect the detrimental environmental effects are great enough in themselves to warrant cancellation of this portion of the program.

Laser and kinetic kill weapons: The PEIS does not really deal with the detrimental environmental effects that will result from the process of developing, testing and deploying laser and kinetic kill weapons. Yet, these weapons are integral to the entire program. We understand there are still many problems to be solved if these science fiction fantasies are to be translated into reality. These problems and the dangers posed to the environment should be included in the PEIS. We suspect that they are great enough to warrant cancellation of the space weapons program.

Nuclear power in space: It is posited that the space platforms may include as many as twenty (or even more) satellites in a constellation, kept in space for years with their own power system. What is that power system? We know that nuclear power has been considered, which we believe would carry us in a very dangerous direction. Possible power systems and their negative effects on the environment must also be realistically examined. We believe nuclear power in space would be an unacceptable alternative.

Weapons in space: The PEIS considers, albeit inadequately, only the question of space based interceptors as part of the missile defense program. It is clear, however, from documents like the *Air Force Transformation Flight Plan,* that the Pentagon intends to use this same laser and kinetic kill technology for both offensive and defensive attacks on satellites of other nations and for offensive and defensive destruction of targets on earth. Other weapons not suitable for missile interception, like the so-called "Rods from God," are also being planned. All of this is in clear violation of the intent of the 1967 treaty on the Peaceful Uses of Space, and it is a direction in which no civilized nation should proceed.

Why is our military moving to weaponize Space at a time when there is more hope than ever before in history of realizing the visions set forth in the American Constitution, the European Union, the United Nations Charter and the Universal Declaration of Human Rights? Other nations do not welcome United States plans for unassailable superiority in space and for global and planetary domination. We are actually forcing other governments - like those in the European Union, China, India, Russia and Brazil – to cut back on their social programs in order to develop their own military space programs in self-defense. Why must we threaten all the cooperative international institutions that nations have built together, with so much difficulty, over the past sixty years and force the world's peoples back on the road to global war?

We are women with a deep love for this planet and its peoples. We know well the horrors of war and we know that women and children suffer those horrors in full measure. It is for the sake of our sisters and their children around the globe, and for the sake of men as well, that our organization has worked for ninety years to develop alternatives to war. We have striven tirelessly for international institutions like the United Nations and the World Court, for international law, for conflict management and prevention, and for the meeting of basic human needs. We continue to have faith – based upon experience --that the nations and peoples on this planet, working together, can develop a world free of war with liberty and justice for all. We do not want our own nation, which has in the past contributed so much to the growth of democracy and human rights in the world, to now lead our human race into the untold horrors of Armageddon.

We urge abandonment of concepts like space weapons and war in space as well as suspension of the entire Missile Defense System. The immediate threats to the environment are reason enough to lay down the program. The threats to the planet and its peoples, if the war fighters ever get the battles for which they plan, are beyond contemplation.

In peace,
Ellen Barfield
Ellen Barfield, Co-chair
Carol Urner
Carol Urner, co-Chair

DISARM: Dismantle the War Economy Campaign
U.S. Section, Women's International League for Peace and Freedom

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November 15, 2004

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Hazardous Waste

Dear Friends,

This is the fourth comment by Women's International League for Peace and Freedom (WILPF) on the Missile Defense Agency (MDA) Programmatic Environmental Impact Statement (PEIS). It is submitted by members of the DISARM: Dismantle the War Economy Campaign. It concerns the detrimental environmental impact of hazardous waste from various aspects of the Ballistic Missile Defense (BMD) program.

Acid rain: The MDA itself notes in the PEIS the possibility of acid rain caused by rocket launches: *In biomes where rain is a frequent occurrence, launches with solid boosters have an increased likelihood of contributing to acid rain, thereby increasing the amount of HCl deposited in regional surface waters. In areas with low velocity of surface and groundwater movement and relatively shallow ground water table it is possible that deposition of acidic water may impact water resources. The potential for and extent of impact would need to be examined in site-specific environmental analysis. (item 4-60)*

The MDA knows at present from where ground based interceptors will be launched, and site specific studies should be absolutely required in the PEIS.

Ammonium Perchlorate: This toxic rocket fuel additive is already a dangerous pollutant in California and the southwest. Across the United States some 20,000,000 people already have their drinking water contaminated by perchlorate. Further poisoning of the ground water and rivers from perchlorate is simply unacceptable. We must not further endanger the health and lives of people the BMD system claims to protect. We need to find ways to preserve the health of our people and our environmental systems, and not contribute further to their destruction.

Other hazardous waste: The MDA promises to dispose properly of hazardous materials from activation of laser weapons, such as chemical simulants, laser chemicals, asbestos, lead based paint, polychlorinated biphenyls, radon gas. However past experience tells us that military test sites are frequently left polluted and with ecosystems and surrounding communities endangered.

When it comes time for decommissioning the military often finds it does not have the technology, or the funds required, to clean up damaged sites. This has certainly been true of other complex systems, like those involving chemical and nuclear weapons. In those cases there is still uncertainty about how to safely destroy or store decommissioned weapons and the associated toxic wastes. MDA needs to address these questions satisfactorily in advance. We suspect they are not addressed because costs involved would be prohibitive and in some cases the technology for disposal does not exist.

Hazards of use: Completely missing in this PEIS is an analysis of the hazards of use if the BMD system is ever employed. This is not a benign system, and possible hazards should be investigated. What would be the effect of a successful intercept over the Pacific Ocean or seconds after firing by another nation? What would be the extent of nuclear fall-out or the expectations of damage from an explosion of the incoming weapon? What would be the environmental effect of a successful intercept of a nuclear weapon over the United States, resulting in a high altitude nuclear explosion? Could electrical and communications systems across the US be destroyed? Could satellites be destroyed? Is it possible that the use of these interceptors to protect U.S. citizens could actually result in unintended destruction? Might other non-U.S. territories, in the path of the weapons, be harmed by interceptions and nuclear explosions above their areas or by debris falling onto their territory? What will be the possible effects on people and the environment on earth below if MDA war fighters actually use their weapons in space or in the skies?

Effect of hazardous and toxic waste on minority communities: As an organization we have a strong concern for human rights and racial justice. We note that the Environmental Impact Assessment requires consideration of undue negative impact on minority communities. It is our understanding that the test sites are mainly on Indian lands or on lands belonging to Marshall Islanders. The statement in the PEIS that *"Environmental justice analyses require information about local communities, and therefore will be analyzed in site specific environmental documentation."* is hardly adequate. We know what damage has been done to such communities already by bombing ranges (as in Puerto Rico) or nuclear weapons testing (as in the South Pacific and on Indian lands in the U.S. southwest). Such an analysis should have been made before the deployment and testing began. The program should be halted until thorough analysis is made, and it should not continue if there is evidence of detrimental effect on these populations and their environment.

We have been able to list only a few of our many concerns about this Draft PEIS, and to discuss them only briefly in our four comment papers.

We are convinced, however, that there are far too many questions for this program to be allowed to proceed. Not only is there a vast array of concerns regarding its adverse effects on the environment, there is also the overriding concern that pursuit of a Ballistic Missile Defense System will destroy all hopes of halting nuclear weapons proliferation and all hopes of continuing to develop as a world community of sovereign nations ruled by law. This system is being designed in a time of peace for global war – and its very existence can make that war inevitable.

We believe that the BMD program should be immediately halted or, at the very least, a moratorium should be declared and a period of full examination of the system, its costs, and its dangers occur. The consequences are too great, the dangers too dire, to let development continue as at present.

In peace,

Ellen Barfield

Ellen Barfield, co-Chair

Carol Urner

Carol Urner, co-Chair

DISARM: Dismantle the War Economy Campaign
U.S. Section, Women's International League for Peace and Freedom

BARBARA CARTWRIGHT

November 16, 2004

MDA BMDS PEIS
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9300 Lee Highway
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To whom it may concern,

I am alarmed that the Missile Defense Agency has authorized itself to continue research on Star Wars. I am opposed to any further development of a Star Wars program and strongly believe that such moneys would best be used on programs to improve the nation's health care, the nation's environmental problems, and to broaden educational opportunities for all Americans.

I believe the "no action alternative is an insufficient brake to further Star Wars developments. I strongly urge a intensive rewriting of PEIS

Sincerely, Barbara Cartwright

Barbara Cartwright

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, DC 20240

TAKE PRIDE IN AMERICA

NOV 1 8 2004

ER 04/701

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Ladies/Gentlemen:

The United States Department of the Interior has reviewed the Department of the Defense, Missile Defense Agency's (MDA) draft programmatic environmental impact statement (DPEIS) for the Ballistic Missile Defense System (BMDS) and offers the following comments.

Air Quality and Pollution

The Department's National Park Service (NPS) commends the MDA for recognizing that review requirements under the National Environmental Policy Act (NEPA) are not the same as those involving conformity and its willingness to comply with both NEPA and the conformity regulations. The Department also commends the MDA for examining potential impacts on air quality, including its recognition of visibility as an important issue, and looks forward to future reports that include an examination of visibility impacts.

Section 3.1.3 Biological Resources

Pages 3-16 to 3-17: The portion titled "Definition and Description" emphasizes consideration of Federal and State listed species, or species proposed for listing. However, NEPA requires that other species that may be impacted by the proposed activity must also be evaluated throughout the DPEIS. See also page 4-42, subportion "Launch/Flight Activities," where impacts to only species of concern are addressed. We recommend that the DPEIS address all applicable species

Pages 3-17 to 3-18: In the portion titled "Impact Assessment," we recommend the following text be inserted to address requirements in the referenced laws:

> If the proponent of the proposed activity determines that migratory bird species may be adversely impacted, then the proponent should confer with the Department's Fish and Wildlife Service's (FWS) Regional Migratory Bird Program to ensure compliance with the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act, where applicable. Under the MBTA, the taking of migratory birds is not authorized without a permit. The project proponent should also confer with the Service to determine if conservation measures may be implemented to minimize or avoid take of migratory birds.

Page 3-19. In the subportion "Determination of Significance," we recommend that reference to the MBTA be incorporated. We also recommend that the final PEIS indicate that military readiness activities implemented in the future by the MDA should be in compliance with the rule currently being finalized by the Service, "Migratory Bird Permits: Take of Migratory Birds by DoD."

Section 3.1.9 Land Use

Page 3-31: In the portion titled "Impact assessment," we suggest referencing the Service National Wildlife Refuges.

Section 4.1.1.1 Weapons – Lasers

Page 4-26: In the portion titled "Biological Resources," under the subportion "Land and Sea Operating Environments," we recommend adding text that indicates that hydrochloric acid could have an effect on shorebirds and waterbirds (in addition to waterfowl, which are already referenced).

Page 4-27: In the last paragraph under the subportion referenced above, we recommend that the text specify the maximum noise level, if available, for which animals "generally return to normal activities within a short time following noise disturbance." Most wildlife has a limited tolerance to noise. We recommend specifying the threshold at which this tolerance level would generally be exceeded and when adverse effects may occur. See also page 4-43 where impacts to birds from noise disturbance are discussed in greater detail. These two sections should be in agreement with each other. The statement on page 4-27 is not in concurrence with the discussions on page 4-43, which indicate there may be more than minor disturbances

Section 4.1.1.3 Sensors – Radars

Page 4-64 to 4-65: We believe the analysis of impacts on birds from radar in the "Biological Resources" portion is outdated and inadequate. The first paragraph of this portion does not address the potential effects of radar on very large flocks of migrating birds. Even if a bird is not "within the most intense area of the beam for any considerable length of time," there is insufficient evidence to support the statement that no significant adverse impacts to birds would occur. The 1993 report that is referenced to support this conclusion is outdated.

We recommend the analysis describe what constitutes a "relatively small" beam size. A beam going through a dense flock could have an adverse effect on birds, particularly for those species which are already significantly in decline. We recommend that this potential adverse effect be described.

We recommend that this section discuss the potential of using NEXRAD (Next Generation Weather Radar) to help evaluate when large flocks may be in the testing area. NEXRAD could provide valuable information regarding times when testing should not occur to reduce biological impacts. This technology is currently being used by the Air Force to reduce the potential for air strikes and by the Department of Defense to identify important stopover habitat in relation to Department of Defense installations.

We recommend that an avian physiologist, particularly one very knowledgeable of electromagnetic radiation, carefully review the effects of this proposed activity.

In reference to the Cobra Dane study, it should be noted in the DPEIS that arctic foxes, which are very efficient predators, are present on Shemya and other Aleutian Islands, and would quickly remove evidence of any bird kills. Lack of evidence of bird die-offs under these conditions does not provide solid evidence that they aren't occurring.

Bird collisions with radar equipment, particularly towers, can have significant impacts on birds. Estimated annual bird kills from collisions with communication towers (radio, television, cellular, and microwave) range from four- to five-million, both from direct collisions with the towers themselves and with guy wires. Tall radar towers, i.e., those above 199 feet MSL (mean sea level), are of particular concern. The greatest impact occurring from towers illuminated at night with solid or pulsating incandescent red lights. In addition, the potential for tower collisions significantly increases at night under cloudy or otherwise low visibility conditions.

Because of these impacts, the MDA should follow the FWS's "Interim Guidelines For Recommendations On Communications Tower Siting, Construction, Operation, and Decommissioning - 2000," for both existing and proposed radar towers. These guidelines should be referenced in the DPEIS as applying to radar equipment. They also should be applied to Re-Radiation Towers discussed in the second paragraph on page 4-77.

Section 4.1.1.5 Sensors - Laser Sensors

Page 4-73: Under the portion titled "Biological Resources," we have similar concerns for potential impacts on migratory birds from laser sensors as those stated above for radar equipment. This is particularly true for the use of land and sea-based lasers and in situations where large flocks may be present. Although the lasers may not directly hit birds or other wildlife on the ground, impacts to birds in the air could be significant. We recommend that these potential impacts be described.

Regarding the Nominal Ocular Hazard Distance, the DPEIS concludes that impacts to wildlife from a space-based laser sensor would be insignificant because it is unlikely that the laser would be directed towards the Earth's surface and, if it were, distortion from atmospheric conditions would reduce the radiance level. It further concludes that the Earth's surface would likely be beyond the Nominal Ocular Hazard Distance. This conclusion is not well supported. We recommend that the DPEIS identify how "likely" it is that the Earth's surface would not be beyond this specified distance.

Section 4.1.1.9 Support Assets - Infrastructure

Page 4-89 to 4-90: In reference to the first paragraph under "Biological Resources," we note that the construction of infrastructure, depending upon its extent, can significantly increase surface runoff. This can negatively impact surrounding habitats, particularly wetlands and other sensitive habitats. Impacts to fish, wildlife, and plants from pollutants could be more than temporary depending upon the pollutant and length of exposure. Depending upon the species in the project area, construction could have a larger area of disturbance than 50-feet, particularly for nesting bird species. We recommend that this section describe these possible impacts.

We recommend that the second paragraph indicate that site preparation and installation could negatively impact waterbirds utilizing the shore environment, particularly during breeding season.

In the third paragraph, we recommend that the description of behavioral responses to construction include nest abandonment and alteration of migration routes of larger mammals.

We recommend that the fifth paragraph list compliance with the Marine Mammal Protection Act, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act as required, where applicable. These regulatory references should also be inserted in the portion titled "Biological Resources" under Section 4.1.1.10 Support Assets - Test Assets.

Section 4.1.2.3 Biological Resources

Page 4-105: Under "Integrated Ground Tests," we believe that the conclusion of insignificant impacts is not sufficiently justified or supported. This section lacks information regarding the size and orientation of the operating radar sensors. It also does not describe the anticipated increased number of these operating radar sensors.

Section 4.4 Adverse Environmental Effects That Cannot Be Avoided

Page 4-133: As stated above, we believe that statements of no significant impact are not sufficiently justified or supported. This section indicates Best Management Practices would be implemented to mitigate adverse effects. However, the DPEIS does not provide sufficient information regarding what these measures might be or what would be recommended. In addition, the conclusion that "those [effects] that could not be avoided should not result in a significant impact to the environment" could be viewed as arbitrary since those effects are insufficiently described.

Appendix H Biome Descriptions

Page H-106: We suggest expanding the discussion of "environmentally sensitive habitat" for the savanna biome. Currently, the discussion consists only of the following two sentences: "National parks and reserves have been established to preserve and protect threatened vegetative

and wildlife species in the Savanna Biome. There are several National Wildlife Refuges along the Gulf Coast."

Technical Comments and Suggested Corrections:

Appendix G Applicable Legal Requirements

Page G-10:

- Under the heading United States, in the first line and after the phrase "The Endangered Species Act of 1973" add, "as amended."
- After the phrase "requires all Federal," delete "departments and" so the line reads "requires all Federal agencies to seek."
- In the second line, delete the word "species" after "endangered."
- In the third line, after the phrase "The Secretary of the Interior was directed," insert "by the Endangered Species Act."
- In the fourth line, after the phrase "Endangered species" replace "designation" with "listing."
- In the second paragraph, last line, delete "an adequate" and insert "integrated"; delete the phrase "in place at the sites" and replace it with "determined to be of benefit to the species", so the line reads ... "from critical habitat designations if an integrated natural resource management plan is determined to be of benefit to the species."

Appendix H Biome Descriptions

Page H-7:

- The scientific name of the northern sea otter is *Enhydra lutris*, not *Eumetopias jubatus*.

Page H-39:

- In a discussion of the deciduous forest biome in the northeastern States, red spruce and balsam fir forest types are listed. We note that spruce and fir are evergreen conifers, and forests dominated by them are not generally considered components of a deciduous forest biome. We also note that the preceding description of the taiga biome on pages H-16 through H-29 does not refer to balsam fir, its most prevalent tree species.
- Tropical and subtropical moist broadleaf forests are described as components of the biome; as the text notes, these forests are "dominated by semi-evergreen and evergreen tree species" and thus may be out of place in discussion of a deciduous forest biome.

- A list of examples of "threatened and endangered vegetation [sic]" in this biome includes three species from the eastern and southern U.S. and a species of moss endemic to evergreen (not deciduous) forest on the island of Madeira, which may not be the best grouping of examples to illustrate listed species in the "inland deciduous forest biome."

Page H-40:

- The discussion of wildlife of the deciduous forest biome indicates that the Florida panther "...inhabit[s] the lower coastal plains and flatlands of the middle portion of this biome." The Florida panther is found only in peninsular Florida, which would not be considered the middle portion of this biome. We suggest making this clear or deleting reference to the Florida panther is this statement.

Page H-41:

- A list of threatened and endangered wildlife includes the American black bear as if it were listed range wide; however, it is the Louisiana subspecies (*Ursus americanus luteolus*) that is actually listed as Federally threatened. *Ursus americanus* is listed as threatened due to "similarity of appearance (T (S/A))" throughout the historic range of the Louisiana black bear, which includes Louisiana, Texas, and Mississippi and is, therefore, subject to a special rule as outlined in 50 CFR 17.40(i). The black bear is not federally listed throughout the remainder of its range.
- The species *Achatinella mustelina* is attributed to hammocks in the Everglades; however, it is a snail endemic to tropical evergreen forests in Hawaii.
- The West Indian manatee is incorrectly given the scientific name of an African species (*Trichechus senegalensis*). It is correctly identified as *Trichechus manatus* in Exhibit H-6 on page H-42.

Page H-42:

- The scientific name of the leatherback sea turtle is *Dermochelys coriacea*, the DPEIS incorrectly identifies its scientific name as *Ammospiza caudacuta*.

Page H-43:

- Gorillas are incorrectly listed as inhabitants of East Asian tropical and subtropical moist forest.

Page H-90:

- *Ostrya virginiana* is given as the scientific name of the ironwood introduced on Pacific islands. However, this is a species of eastern North America; it is likely the author had in mind a species of *Casuarina*, also commonly known as ironwood.

Page H-93:

- *Esox lucius*, the northern pike, is attributed to offshore areas near the Pacific Missile Range on Kauai; however, this species is not found in the waters around the Hawaiian Islands. It is likely the author had a different species in mind.

Page H-104:

- In a discussion of the savanna biome, the harpy eagle is listed as one of its "common bird species." However, this eagle is an extremely rare bird of deep forest habitats.

We appreciate the opportunity to provide these comments. Should you have any questions please do not hesitate to c

Sincerely,

Willie R. Taylor
Director
Office of Environmental
Policy and Compliance

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

November 17, 2004

Missile Defense Agency
Ballistic Missile Defense System PEIS
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Dear Mr. Lehner:

In accordance with our responsibilities under Section 309 of the Clean Air Act and the National Environmental Policy Act (NEPA), the Environmental Protection Agency (EPA) has reviewed the Missile Defense Agency's (MDA) Ballistic Missile Defense System (BMDS) Draft Programmatic Environmental Impact Statement (DPEIS) (CEQ # 040438).

The DPEIS identifies, evaluates and documents, at the programmatic level, the potential environmental impacts of activities associated with the development, testing, deployment, and planning for the eventual decommissioning of the BMDS. It considers the current technology components, support assets, and programs that make up the proposed BMDS as well as the development and application of new technologies.

EPA commends the efforts that MDA has commenced in p comprehensive and well organized document. We also appreciate the extensive environmental analysis that is available for many of the the proposed BMDS. Based on our review of the DPEIS, we have rate - Lack of Objections (see attached "Summary of EPA Rating System"). Although EPA has no objections to the proposed action, there are a few issues that should be clarified.

1) General Comments:

a. To assess the impacts of implementing the proposed BMDS, the DPEIS characterized the existing condition of the affected environment in the locations where various BMDS implementation activities are proposed to occur. MDA has determined that activities associated with the proposed BMDS might occur in locations around the world. Therefore, the affected environment has been considered in terms of global biomes, broad ocean areas, and the atmosphere. This has resulted in the DPEIS being very conceptual and general in nature. EPA understands that once potential BMDS locations are determined, more detailed site-specific documents will be prepared. Through the discussions on the "block approach" or the "block development process", the DPEIS has given clear indications of when follow-on NEPA analysis will occur. We agree with this approach. However, while the documents give representative examples of past, current, or proposed locations where proposed activities may occur within each biome, EPA recommends that the EIS discuss the criteria that MDA will use in making future decisions for site-specific locations.

b. The resource areas considered in this analysis are those resources that MDA believes can potentially be affected by implementing the proposed BMDS. EPA agrees that some resource areas are site-specific or local in nature and, therefore, cannot be effectively analyzed in this type of programmatic document and that the potential impacts on these resources are more appropriately discussed in subsequent site-specific documentation tiered from this PEIS. However, EPA recommends that the final document discuss the existence of multiple species habitat conservation planning efforts that are proximate to DoD lands and the potential impacts of debris on marine and aquatic ecosystems.

c. As suggested by CEQ regulations, MDA has taken advantage of the extensive environmental analyses that already exist for many of the existing components of the proposed BMDS by incorporating these materials into the DPEIS by reference. However, some of these documents are greater than 10 years old. The PEIS should confirm the validity of the information in these documents.

2) Perchlorate Comment: Because there have been differing interpretations of the science associated with the impact on human health from low level exposure to perchlorate and in the interest of resolving scientific questions, EPA, the Department of Defense, the Department of Energy, and the National Aeronautics and Space Administration - members of a broader Interagency Working Group on Perchlorate led by the Office of Science and Technology Policy - have referred scientific issues and EPA's 2002 Draft Health Assessment on Perchlorate to the National Academy of Science (NAS) for review. NAS is currently conducting a study to determine the best science and model to use for determining the health impacts and standards for perchlorate. A report on this study is expected to be completed by the end of 2004. EPA recommends that the results of the report be incorporated into the FPEIS.

We appreciate the opportunity to review this DPEIS. We also look forward to reviewing the FPEIS related to this project. The staff contact for the review is
can

Sincerely,

Anne Norton Miller
Director
Office of Federal Activities

Enclosure: Summary of Rating Definitions

SUMMARY OF EPA RATING SYSTEM

Rating the Environmental Impact of the Action

- **LO (Lack of Objections)** The review has not identified any potential environmental impacts requiring substantive changes to the preferred alternative. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposed action.
- **EC (Environmental Concerns)** The review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact.
- **EO (Environmental Objections)** The review has identified significant environmental impacts that should be avoided in order to adequately protect the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). The basis for environmental objections can include situations:
    1. *Where an action might violate or be inconsistent with achievement or maintenance of a national environmental standard;*
    2. *Where the Federal agency violates its own substantive environmental requirements that relate to EPA's areas of jurisdiction or expertise;*
    3. *Where there is a violation of an EPA policy declaration;*
    4. *Where there are no applicable standards or where applicable standards will not be violated but there is potential for significant environmental degradation that could be corrected by project modification or other feasible alternatives; or*
    5. *Where proceeding with the proposed action would set a precedent for future actions that collectively could result in significant environmental impacts.*
- **EU (Environmentally Unsatisfactory)** The review has identified adverse environmental impacts that are of sufficient magnitude that EPA believes the proposed action must not proceed as proposed. The basis for an environmentally unsatisfactory determination consists of identification of environmentally objectionable impacts as defined above and one or more of the following conditions:
    1. *The potential violation of or inconsistency with a national environmental standard is substantive and/or will occur on a long-term basis;*
    2. *There are no applicable standards but the severity, duration, or geographical scope of the impacts associated with the proposed action warrant special attention; or*
    3. *The potential environmental impacts resulting from the proposed action are of national importance because of the threat to national environmental resources or to environmental policies.*

Adequacy of the Impact Statement

- **Category 1 (Adequate)** The draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.
- **Category 2 (Insufficient Information)** The draft EIS does not contain sufficient information to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the proposal. The identified additional information, data, analyses, or discussion should be included in the final EIS.
- **Category 3 (Inadequate)** The draft EIS does not adequately assess the potentially significant environmental impacts of the proposal, or the reviewer has identified new, reasonably available, alternatives, that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. The identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. This rating indicates EPA's belief that the draft EIS does not meet the purposes of NEPA and/or the Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS.

DC_M7806

October 15, 2004

Rick Lehner
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Dear Mr. Rick Lehner,

I am writing today to support the "No Action" alternative to deploying a missile defense system. The United States should not deploy a missile defense system unless it will improve the overall ecological, political, and security environment. On all three grounds, the proposed system fails.

Deployment of the Bush administration's proposed missile defense system threatens the global environment. It will increase the likelihood of a nuclear catastrophe by impelling Russia to maintain a larger nuclear arsenal on high alert than it otherwise would, and by driving China to build and deploy a larger arsenal than it otherwise would. The impact of a nuclear war, either accidental or intentional, would dwarf any other environmental nightmare scenario one can envision.

Moreover, the system does nothing to improve our security environment. It has yet to be tested in realistic conditions and would be ineffective against a real attack.

Deployment should be halted until the Programmatic Environmental Impact Statement is finished and the system succeeds in realistic testing.

It is also my understanding that the deployment is being made without the radar system because it is faulty. How, might I ask will a missile be guided?

Sincerely,

James Roberts

[illegible]

October 14, 2004

Rick Lehner
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Dear Mr. Rick Lehner,

I am writing today to support the "No Action" alternative to deploying a missile defense system. My perspective is that of a long time resident of Interior Alaska familiar with the Fort Greely area where one of the missle sites is currently under development. Unfortunately, the selection of this site was not adequately evaluated in relation to the environmental sensitivity of this area. Inadequate consideration was given to the fact that the site sits on top of the flowage of a unique aquifer that flows through the glacial outwash gravels from the Alaska Range mountains to the south, under Fort Greely, and emerges as springs that feed the Delta Clearwater River and lake system. Because of the upwelling water of the Delta Clearwater system it is one of the most productive salmon spawning complex and young salmon rearing area on the entire Yukon-Tanana River system. Any significant leakage or spill of contaminants, inclusive of fuels, and radioactively contaminated water or other materials would have the potential for devastation to both the commercial and subsistence fisheries of the Yukon River aned Bering Sea through direct affects on the fish, as well as the thousands of people dependent upon the fish for their nutrition, health, and economy. Additional studies need to be done to assess this potential threat to the Alaskan environment and its people and to assess the possible need for mitigative planning, spill contigency development, and testing for background leakage levels from the post World War II use of Fort Greely as a biological and chemical warfare testing site. The United States should not deploy a missile defense system unless it will improve the overall ecological, political, and security environment. On all three grounds, the proposed system fails.

Deployment of the Bush administration's proposed missile defense system threatens the global environment. It will increase the likelihood of a nuclear catastrophe by impelling Russia to maintain a larger nuclear arsenal on high alert than it otherwise would, and by driving China to build and deploy a larger arsenal than it otherwise would. The impact of a nuclear war, either accidental or intentional, would dwarf any other environmental nightmare scenario one can envision.

Moreover, the system does nothing to improve our security environment. It has yet to be tested in realistic conditions and would be ineffective against a real attack.

Any decision for deployment should be delayed, at least until the Programmatic Environmental Impact Statement is finished and the system testing is completed.

Sincerely,

DC_O0002

Missile Defense Agency
BMDS PEIS
Comment Form

Name: Angy Chambers (POC)
Organization: 45 CES/CEV

Address1:
Address2:

Comments:

From 45 SW/JA (Capt. Elizabeth Patrolia),

Pages 4-84 and 4-90 -The sentence reads, " Should the impacts affect a threatened or an endangered species or its habitat, essential fish habitat, jurisdictional wetlands, or another regulated resource then in addition to analysis under NEPA and other applicable laws (Clean Water Act, Endangered Species Act), regulatory agency consultation would be required."

Although this is a true statement, we believe it can be phrased more concisely. The language as written suggests that section 7 consultation under the Endangered Species act will be obtained when and if during the course of our actions we impact a threatened or endangered species. 50 C.F.R. 402.10 (a) states, "...The conference is designed to assist the Federal agency and any applicant in identifying and resolving potential conflicts at an early stage in the planning process."

This statement in the code leads us to the conclusion that we should attempt to consult prior to adverse affects on endangered species when known in advance. We suggest adding this additional sentence to follow what was quoted in the first paragraph, "The appropriate federal agency must be consulted under section 7 of the Endangered Species Act when site specific analysis indicates the continued existence of a threatened or endangered species is likely to be jeopardized."

From Brian Barfus (Environmental Support Contract),

CCAFS has tremendous infrastructure to support this project and many organizations to provide various environmental services such as hazardous waste disposal for such a project. It is not possible to predict the impacts on this facility until we get a better idea as to what activities will take place at CCAFS. Will there be any new facilities constructed? Can present organizations provide the required services to support the new activities and associated support facilities for this project? We need this kind of information to properly evaluate the environmental impacts of this project at CCAFS.

From Angy Chambers (45 CES/CEV),

No comments at this time. Further documentation would be required in order to assess impacts to natural/cultural resources at Cape Canaveral AFS.

1

DC_O0002

Submit comment form via mail to:
MDA BMDS PEIS
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Submit comment form via fax to:
MDA BMDS PEIS
1 (877) 851-5451 (toll-free)

2

DC_PHO0007

Good evening everyone. Thank you for the opportunity to have citizens' comments. I think we've said that the environment is much broader than what this statement calls for. The environment is a social and cultural environment that we need to take into consideration as we consider building such a new and costly provocative system.

The National Intelligence Estimate of 2001 for the Bush Administration says, and I quote, An attack on U.S. territories is more likely to be -- we are more likely to be attacked by countries or terrorists by using ships, trucks, airplanes or other means, rather than long-range ballistic missiles.

We're still in the era of the Cold War in thinking about these missiles and this program to create this artificial and flawed umbrella for the people of this country. What are the effects on other countries of this provacative system? It is thought likely that China will increase its production of nuclear weapons to overwhelm this system, which is very easily overwhelmed by decoys and numbers. This system, as we now know it, is meant to ideally knock out a very few incoming missiles, not at all the kind of attack that possibly could occur. It is flawed in that respect.

The Pentagon itself in an analysis called the Ballistic Missile Defense System, a Case Study Against Rushing Forward on a Missile System. The Pentagon itself said that. And yet we're -- we have spent a hundred billion dollars. We're planning to spend 83 billion more over the next ten years and we have nothing to show for it except neglected communities, depleted healthcare systems and actual environmental neglect of the real environments that we all daily live in.

This proposal that we're asked to address tonight does not contain a real No Option Alternative not to build the system, to abandon it. That is what I think most of the people in the United States and the world would affirm. This system's impact on traditional arms control and disarmament efforts would be profound. We've already vitiated the Anti-Ballistic Missile Treaty under this Administration. We're preparing to resume nuclear weapons testing at the Nevada test site. We're building a whole series of new nuclear weapons, the mini nukes and bunker buzzards.

We're prepared to fight preemptive wars and yet this antiquated system that is going to cost you and I and our fellow Americans the treasures of our society that are already depleted by the Iraq war and other weapons spending, we're asked to do this. And I say we must abandon this program and utilize our resources in more constructive ways and practicing the ways of diplomacy negotiations and building alliances, instead of acting unilaterally, which is what this program does. Thank you.

DC_PHO0009

Hi. I came here from Salinas to speak on this. And in Salinas they're proposing closing all of our public libraries. Why? Because they don't have enough money. Well, where is the money going? I propose that 1.3 trillion dollars for Star Wars is a good example of where the money is going. Closing all of the public libraries completely in a town that is 66 percent Hispanic American, in a town that produces 80 percent of the lettuce you eat.

Let's take a look at what the program is. And I'll address it environmentally. I have copies of my statements if anybody wants it. Here you go. Here. Pass them around. Statements from MacGregor Eddy. I'm an advisory board member of the Global Network Against Weapons and Nuclear Power in Space regarding the Programmatic Impact Statement of the PEIS Ballistic Missile System presented October 19th, Sacramento, California. One, the 515 launches which is far more than the 99 commercial launches that are proposed.

By the way, I came here expecting a fairly honest presentation of the PEIS and I was shocked at the scummy lies I heard by people I regard as honest people. It's ridiculous that the -- there is 515 launches proposed for Star Wars. That is five times the amount that would be launched under the programs that are non-Star Wars. And you can look this up for yourself. Don't trust me. Check it out.

The second thing is the PEIS is based on the Star Wars program as proposed -- and here we have a statement. Okay. This statement was made by General Henry Tray Obering. He's the head of the Missile Defense Agency. So this is not a statement from some conspiracy website. This is a statement from the head of the MDA. What did he say when he was speaking at a Homeland Security conference on a missile defense panel on October 13th in Colorado Springs, Colorado? He was asked about the THAAD, which is the Theater High Altitude Defense Missiles that are scheduled to go into production in 2005. He was asked about these. What did General -- General Henry Tray Obering say about the missiles? He said, quote, These missiles are intended to augment, not replace, the current generation of ground-based midcourse interceptors.

That is what we're talking about here tonight, ground-based midcourse interceptors. In fact, there will be a continued spiraling of the capabilities of missile network with more missiles and additional sites added to the current missiles and expansion of the Theater High Altitude Defense Missiles beyond the initial scheduled 25 missiles. Therefore -- hey, listen. Therefore, the program they're talking about includes far more missiles than the ones they're proposing.

The second thing is the PEIS does not evaluate the environmental impact of No Action Alternative; thus, does not comply to the National Environmental Policy Act. And three, the PEIS does not address the environmental impact of the response to ballistic missile defense systems by other countries. For example, China is planning to increase the number of missiles they have in direct response to our ballistic missile program. And this PE -- this Environmental Impact Report does not address the effect of testing,

deployment and decommissioning of these two missiles in China, which is a direct result of our policy. And this is not included in the Environmental Impact Report.

The report -- since No Action Alternative was not considered seriously in the impact report, I say it is not an impact report at all. Therefore, it has not complied with the legal requirements; therefore, it should be stopped. Thank you.

DC_PHO0010

I'm Rod Macdonald. I'm a professional wetland scientist. I work with identifying wetland ecosystems, their components, soils, water quality, their functionality. I modify them, restore them, recreate them under occasion, so forth. So I know what I'm talking about. I'm a registered wetland scientist, which means, like a structural engineer, I'm educated. But I have a reputation to lose, if I don't get the facts right.

I guess what disturbs me is I read Science Magazine. It comes out 52 times a year. It's uncensored. You'd be surprised of the things you'll see in there. Anyway, there is a lot of discussion about missile systems that comes from the point of view of the National Academy of Science. And, of course, there is a broad range of opinions of scientists, like anyone else. It's sort of a scientific engineer-based discussion.

I want to talk about what an Environmental Impact Statement is supposed to be under the NEPA, National Environmental Quality Act. It's supposed to look at a cradle-to-grave analysis of a project. It's supposed to minimize the impact at every state, in every level, every decision within it. I really think it's a great thing to take a program like this which has a huge cumulative impact and look at it in a systematic cumulative way. That's what it says it does; but, unfortunately, it's not what it does. It provides a false set of figures upon which to compare what the real impacts would be. Instead of trying to look at where we have to go if we want to deploy the system -- I'm not willing to take a stand about whether I agree the system should or shouldn't be built. I think despite all terrorism, the possibility of a missile launched from a disguised container off of the coast is realistic and we'll never know who put it in that container but we'll need to shoot it down.

But my argument isn't with the waste of money, if it may be an overblown system or its provocative nature; but, instead, it really does not address what is going on. And the reason it doesn't is it provides -- I'll look at perchlorates. Perchlorates are important to amphibians. Amphibians are in a worldwide decrease. If you look at the report, all the report ever says is "hazardous waste will be handled and dispersed in accordance with appropriate regulations; therefore, no significant hazardous materials and hazardous waste impact will be expected."

They go through and they say this for every single thing. The vegetation and so forth won't be or "we'll do a tiered-site analysis and a certain site will be affected" but it won't. But the truth is over the decade life of the program, the global level of perchlorates may rise. Amphibians skin needs to be moist. They're very sensitive to all industrial chemicals. Seventy percent of the species are in decline right now, even in habitats that aren't disturbed. Why would we care about them? The mosquitos are coming out. We don't have hard figures. We don't have real analysis. We're told this is a half a percent. What they're disguising there is most of the chemicals are residual from former manufacturing processes. And even so, the largest contributor -- as a scientist, I'm simply telling you, the largest contributor actually is the manufacturing, testing, open detonation of old rocket motors and the whole thing.

DC_PHO0010

Just to say there would be no impact -- this is a negative deck. We've all seen negative decks. They go through and check off negative deck. Negative deck. Negative deck. This isn't an honest -- this isn't a scientific discussion. I'm aware of what NEIR is. I've dealt with them for 25 years. Thanks.

DC_PHO0011

The PEIS underplays many environmental effects of the BMDS. The Ballistic Missile -- I'm sorry. The Ballistic Missile Defense System PEIS does not address several of my scoping comments to start with and does not adequately address several risks, including exposure to increased levels of toxic pollutants from a dramatic increase of missile launches.

As we know, the -- the perchlorates are used in the self-propellants in the formation of a key thyroid hormone which are critical for growth and development of fetuses and children. The PEIS proposes to allow over thirty-fold higher levels of perchlorate at 200 parts per billion than proposed by the State of California, which is six parts per billion. Thus, many rocket launches will inject chemicals including aluminum oxide, hydrogen chloride and hydrochloric acid directly into the upper atmosphere, thereby depleting the ozone. The PEIS does not address the direct injection of the chemicals high into the atmosphere.

Secondly, the BMDS PEIS underestimates the risk of health and safety of BMDS missiles accidentally shooting down civilian and/or friendly military aircraft. BMDS has failed to mention the U.S. missile systems have a history of accidentally shooting down aircraft. Consider the U.S. has seen the Pac-3 missiles, which are -- which are in the PEIS, actually shot down several U.S and allied jets -- two or three in this case of -- I'm sorry -- in two of the cases of the recent invasion of Iraq. There is also Flight TWA 800. And even though several people saw streaks going up toward it, the people that saw it were never allowed to testify. The -- the point is that the activation of the BMDS risk accidentally shooting down civilian airliners is not even considered in the BMDS. It's a risk to health and safety.

While the BMDS states that warning will be provided to enable time to clear the air space, it's highly doubtful that such time would be allowed in such an emergency. Also, the PEIS underestimates the effects of space to reach from high altitude midcourse missile intercepts in the destruction of satellites, particularly at high altitude.

Furthermore, while the PEIS considers testing the BMDS on targets of opportunity, no mention is of the space debris resulting from U.S. targets of opportunity or other nations' targets of opportunity. The environmental consequences of mini rocket launches needed to deploy and maintain space-based interceptors has not been adequately considered, nor has its environmental consequences of the fuel. They talk about having all of the -- these -- in other words, in Option 2, they have many different interceptors in space that would have a reduced environmental consequence. But there's no consideration you have to launch all of those missiles in the place to get there.

Also, will the space-based satellites use nuclear power sources? Will any BMDS interceptors use nuclear warheads? This was not clearly defined. This is unsatisfactory. The BMDS does not include a real No Action Alternative. Such an alternative does not include further development and testing and deployment of these weapon systems needs

DC_PHO0011

to be considered and included in the PEIS. The PEIS does not consider a No Action Alternative at all. In other words, something that would involve rejoining the UN and -- and many other nations of the world in order to enhance security through treaties and arms control, sovereign approaches; i.e., approaches that provided us with long-term security to date.

Also, the PEIS, has not considered any -- has not considered any radioactive follow-up from interceptive missiles. The effects of war are not excluded for the analysis of NEPA. However, the proposed BMDS action is likely to promote a worldwide weapons of mass destruction arms race and force other nations to prepare a massive retaliation against the U.S., should war ensue. Since the proposed BMDS is very likely to cause a massive arms race, the environmental consequences of a resulting war with nuclear and other weapons of mass destruction should not be ignored.

The PEIS needs to consider the environmental effects that follow up from interceptive weapons of mass destruction, as well as effects of weapons of mass destruction the BMDS fails to intercept. This needs to be considered relative to a true No Action Alternative. Thank you.

DC_PHO0013

Hi. I'm Dan Bacher, Central American Action Committee member and long-time environmental and peace activist. And I suggest an Alternative Number 4, which means scrap the entire PEIS and the whole program that they are presenting here. This is a colossal waste of taxpayers money that could be spent on just about anything else other than this and it would be productive. There is a hundred billion dollars that have been spent and another 83 billion that are planned to be spent over the ten years if this Star Wars goes into effect.

The crazy thing about this is there is no imminent threat of weapons of mass destruction or space weapons at least on Earth. I have three questions that I'd like included in the comment period of the document.

Number 1, are we afraid of the zany folks from Zetaraticuli from launching ballistic missiles at Washington, D.C.? Are we terrified of the peaceful and highly evolved inhabitants of Europa from launching WMD's at New York? Number 3, are we afraid of the wonderful civilization of the third planet from Orion launching a massive terrorist attack here on us in Sacramento? No. I don't think so. Unless the government isn't telling us something about this.

Who are we protecting ourselves against? Okay. What I think that -- a better thing than calling this all of the acronyms that have been given out here on this wonderful PowerPoint presentation, I think it could be summed up as "Lost in Space." The people that came up with the Star Wars technologies whole concept are out of their minds. This is the ultimate corporate welfare project.

You know, I -- I'd like to conclude with the fact that we -- we need to get rid of this whole Star Wars project and the PEIS and everything else and get the weapons contractors off welfare. And when I've been out demonstrating I get this stuff from people, "Why don't you get a job?" Well, I've had a job for years. You know, I've been employed the whole time. What I'd like to say to the people that are proposing Star Wars and the Missile Defense System is to get a job, weapons contractors.

DC_PHO0014

Dan is a hard act to follow. Anyway, turning some of the comments that have already been made relating back to the Environmental Impact Report, the Environmental Impact Report has to consider the chain reactions. The report on cutting down old growth Redwoods considers the effect it will have on the spotted owl. The Ballistic Missile Defense program will have effect on a lot more than just spotted owls. It's not only a likelihood, it's a certainty that other countries will react to us developing a Ballistic Missile Defense System, however flawed it might be. And they will react likely by developing more ballistic missiles to overcome the defense system. I've seen nothing in the environmental report on this system that takes into account how other countries will react.

So the effects of the more missile launches, more rocket fuel contaminates going into the water, more depletion of the ozone are not just those of the Ballistic Missile System being described here. All of the effects of the proliferation of ballistic missiles around the world must also be considered in a serious Environmental Impact Report.

Similarly, with the weaponization of space it has been mentioned that other countries are unlikely to be able to afford similar space-based interceptors. Well, the fact is, the U.S. cannot afford this system either. Nevertheless, it wouldn't take much money to send satellites into space to purposely explode and create space debris that would make the space-based interceptors ineffectual and would also make the communication satellites ineffectual and so on and so forth, basically, sabotage space for military and civilian use.

This should be considered quite seriously in an Environmental Impact Report on this system. I don't see any consideration of that. That would be a very simple way another country could stop the whole system. You know the alternative. This has been alluded to. The alternative has to be considered. The alternative of land, sea, air and space-based defense systems are being considered. The alternative of a diplomacy-based defense system is not considered. In fact, diplomacy seems to be a -- a foreign concept to the current Administration.

But as we now know, UN weapons inspections work quite well to eliminate weapons of mass destruction. And similar systems could be deployed around the world, as was deployed in Iraq, and eliminated all of the weapons of mass destruction. These might not meet the needs of Congress, the President and the likes of Dick Cheney and those with egregious economic conflicts of interest, as Dan alluded; but they would meet the needs of the American people.

Talk about showstoppers. This Ballistic Missile System is a threat to the survival of all living species on Earth. That is a very definite showstopper. Thank you.

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I'm Darien Delu. I'm connected with the Women's International League for Peace and Freedom, the United States section. It's an honor to get to speak to this body because of the other speakers who have come before me, who have covered so many of the critical points that have to be addressed in the Environmental Impact Statement. We have been presented with a document with 700 pages of inadequate information and sidestepping and general ignoring of the real issues involved. Many of these have been raised already tonight and I'll try not to be too redundant.

The -- NEPA provides for consideration of environmental impacts of the MDA proposals. The MDA PEIS finds only limited environmental consequences for the two proposed alternatives. The so-called No Action Alternative creates a straw dog against which to judge the first two alternatives of the MDA.

The focus of my comments will be two-fold. First, I call for a true No Action Alternative, as have others. For example, or specifically, an alternative that goes beyond the failure to integrate anti-ballistic missile system to an alternative that rejects the individual missile defense elements of a BMD System. Secondly, I point out the unaddressed global environmental impact of an accelerated arms race. Such acceleration, as has been repeatedly pointed out this evening, is entirely predictable as a consequence of the U.S. BMD program.

Because of the devastating impacts -- political, environmental, ecological and psychological, as well as merely environmental -- the impacts of a Ballistic Missile Defense Program of any kind, this PEIS must address a true No Action Alternative. The failure of this PEIS to include such a true No Action Alternative violates the requirements of the NEPA process. The absence of a true No Action Alternative allows the PEIS to construct a false comparison with the other alternatives underplaying the different degrees of environmental damage.

According to the PEIS, the proposed action is needed to protect the U.S. from ballistic missile threats. However, the proposal as -- as a BMDS, a Ballistic Missile Defense System in English, will result in an acceleration of the global arms race. As others have already pointed out, in the case of China, if the U.S. implements a BMDS, other countries will feel called upon to create or increase their missile-based weapons deployment systems as well as their nuclear armament in order to prevent -- in order to present themselves as credible negotiation parties with the U.S. and protect the survivability of their weapons.

As others have already pointed out, the PEIS fails to address the chilling possibilities and associated impacts of an accelerated arms race and its increased missile testing. We're not even talking about the devastation a war would cause. And what about nuclear proliferation? The PEIS does not address the many environmental impacts of the entire nuclear cycle connected to nuclear proliferation. The PEIS points out NEPA excludes

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from consideration the environmental impact of a nuclear war or any acts of war. But as human beings, we cannot exclude that in our considerations.

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Good evening. I'm Ellen Schwartz. I'm the Co-chair of the Sacramento branch of the Women's International League for Peace and Freedom. And I thank you for the opportunity to speak here. We know from Gulf War I and the War on Terror and the test results to date for the components of the BMDS that the surgical precision with which U.S. weapons are guided makes them excellent instruments for destroying embassies, wedding parties and a hotels full of journalists. In other words, you honored military gentlemen have trouble hitting your backsides with both hands. If you're -- there, is no way that a kinetic weapon -- is that what you call it? -- hitting a missile with an arrow is going to be able to actually hit any significant number of incoming alleged threatening missiles. You're going to have to use nukes in order to get a broad enough range of destruction to take out any of these alleged incoming threats from Alpha Centauri.

Are you going to test them? Are you going to talk about them in the PEIS? Are you going to talk about the environmental impact of testing nuclear weapons in the atmosphere? Or are you just going to lie in the PEIS and, you know, get it installed and say later, "Oops, we have to have nuclear warheads"? The display outside the hall finds uniformly no significant impacts from any of the phases of the BMDS. Emissions will be disbursed by the wind. It's unlikely any animals will get in the way. Of course, no satellite has ever fallen out of orbit and no rocket vehicle has ever blown up on launch so there is no danger of anything ever going wrong.

Even on your own terms without considering the environmental impact of forcing China, Korea, Iran and everybody else in the world to build their own systems to protect themselves from ours, even without considering the possibility that any of these countries including us might use these systems, the BMDS is a disaster waiting to happen. Every weapon built, sited, tested or even decommissioned is a potential disaster.

Your three alternatives assume a program that is going to be implemented whether we do whatever we say here. And the PEIS and this hearing is nothing than a legal formality. You have no true No Action Alternative; only build it together or build it a little bit at a time and don't test it together.

I'm a little offended that all you want to hear about is the environmental impact of this system; whereas the presentation talks about how we'll all be not safe if we don't build it. If the safety of our country from our alleged enemies is on the table, then so is the impact of causing a war.

What you should do in your own terms is to consider a true No Action Alternative, which is an analysis of the relative emissions of greenhouse gasses and space debris and toxic chemicals and radiation caused by either (A), blowing things up or (B), pursuing broader implementations of existing treaties, such as the Nuclear Non-proliferation Treaty and the Anti-Ballistic Missile Treaty, which would not produce any greenhouse gasses, any space debris and would not blind any animal or destroy any life on Earth. Thank you.

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First, I'd like to thank you, Colonel Graham and Mr. Bonner and Ms. Shaver and Mr. Duke for coming out here and -- and presenting your material and then hearing what the public has to share. My comments are, I hope, going to be very specific and germane to the PEIS. One of the things I want to point out is that the -- our organization I represent is the Physicians for Social Responsibility in Los Angeles. We have about 5,000 members in Southern california. And we have actually worked with Lenny Segal and I believe you've heard his oral testimony as well as written documents regarding the perchlorate and the lack of information that is present in the PEIS.

Most notably, I would like to point out that the timeline of potentially releasing the final document but two weeks after the oral testimony, as well as what anyone else could offer in writing and -- or even six weeks later into -- in the end of January of '05 strikes me that you very well may not take too seriously what we have to say. I would strongly suggest that you factor a time when you can actually take into account the things that the public are suggesting.

I would like to offer some language for other alternatives which would entail a great deal of work on your part in the MDA office but I think it is absolutely necessary. You're clearly aware of the political decisions that led to the formation of missile defenses, in general, coming out of a decision politically that deterrents were no longer sufficient. I feel that this Administration in making that determination is mistaken. But in addition to that, we haven't tethered out the differences in this document between strategic defense defenses against long-range missiles and those of an -- in a theater defenses. And all previous administrations had kept these two missile defenses segregated. And this Administration has blended the two.

And I think to the detriment because theater defenses have actually a promising future, unlike strategic defenses. Theater defenses can protect troops in the field. Theater defenses can protect cities from attack, overseas especially. And they have actually enjoyed some limited success both in the field of testing as well as in the battlefield and also enjoys bipartisan support. There is actually a realistic threat. There are short-range and medium-range missiles that could actually be fired in hostility at American targets or those allies; unlike the strategic long-range missiles which do not really have a basis in reality.

And in addition, theater defenses have a realistic success because the boost phase of a missile is relatively slow and even the descent of a short-range, medium-range missile is much slower than that of the strategic missile, which could be traveling at 10 kilometers per second, which makes it very unlikely to hit. The alternative, it may be politically impossible for you to do this, but I think you should try to have another alternative which would simply be to keep the -- this is probably the presidential candidate John Kerry's position on these matters -- would be to move ahead on theater defenses but to maintain the strategic weapons that the missile defense is -- against long-range missiles to be held

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in research and development stage. And -- and that would be my suggestion for a true alternative.

The other thing I want to bring up is in regards to in the PEIS there is some statements in the effect that some of the space-based interceptors would be placed in geosynchronous orbit, which I believe is some 24,000 kilometers from Earth. To actually get a weapon from 24,000 kilometers out to what would be a low-Earth orbit or even a lower trajectory of a missile within 20 minutes or half hour and do so accurately and to hit the missile is fantasy. And therefore I think the PEIS mischaracterizes any weapon that would be placed in geosynchronous orbit as being an anti-missile weapon. It should simply not be listed as a possibility. That would be -- well, you would be deploying an ASAT -- an anti-satellite weapon. And you should go through the process of actually fielding that before the public and have -- and take your hits for that if, indeed, you're doing that.

The same with the Airborne Laser. There is a very good probability that an Airborne Laser would never work in shooting down a missile in the boost phase and all tests indicate that. But it could be highly effective in a directed energy targeting on Earth for terrestrial targets. And you should be honest about what that weapon might also be used for. It would be helpful to actually not mask the true purposes of some of these weapons.

I believe there needs to be more hearings. The PEIS is insufficient in dealing with cumulative effects, especially in Southern California, as so many of our local contractors are working on the weapons systems. We're bearing the brunt of our environmental impacts of the laser weapon development and many of the rocket launches and the rockets that are being assembled for those launches to launch these 515 launches that may take place over the next 10 years.

I also suggest that you get testimony from the National Recognizance Office, if you have not done so. I'm sure there are considerable concerns about military recognizance assets being false -- being harmed by space debris. Last but not least, I would also suggest that you conduct a space debris analysis, as you have sited in the PEIS, that there may be intercepts as high a 400 kilometers. That either you do testing at 400 kilometers, which is ill-advised because of the debris problem, but how would you know if the weapons work unless you conduct the tests? Or you should actually assume that the weapons won't work because you cannot conduct the tests at 400 kilometers above. Thank you very much.

DC_PHO0024

So this is a show, as we have showstoppers. I'm confused. Well, actually, I -- I was confused by the glossary. It's five pages long and single spaced. And I haven't started yet. The New York Times magazine two days ago asked Wlodzimierz Cimoszewicz, Poland's Foreign Minister to the United States about Polish defense minister, Jerzy Szmajdzinski who recently announced plans to pull all 2500 Polish troops from Iraq next year. Cimoszewicz answered, "It's not true. Our minister of defense mentioned that we would like to end our mission at the end of 2005 but that is not the official position of the government." But when the Times asked Cimoszewics if he had met with the families of the 13 Polish soldiers who died in Iraq, Foreign Minister had replied, "No. I have not."

The Polish government was officially represented by the minister of defense. Which begs the question: Has the defense minister been demoted to coroner/chaplain or how many dead Poles does it take to end the U.S. war in Iraq? Furthermore, Polish Foreign Minister Cimoszewics confirmed the Times figure that 70 percent of Polish people oppose the U.S. war in Iraq. What are we afraid of? The Polish public opinion? The so-called insurgent Iraquis taking up arms against U.S. corporate mercenaries like Cal F. Brown and Root and Halaberten? Ari Fleischer's so-called Operation Iraqi Liberation? That was the original term for this attack, O-I-L. Serves to liberate the resources under those inconvenient civilians impeding corporate access.

The Cold War is over but this fact does not deter the Bush crime syndicate from heating things up. There is no peace dividend as it and any surplus saved in the 90's has been spent since the start of the millennium. The world is a decidedly more dangerous place because the Pentagon has run amuck spending half of our income taxes while mortgaging debt so far as our great grandchildren so it can build so-called "kill vehicles."

Meanwhile, the Pentagon mocks our democracy. It plans, tests, builds and imposes terrible weapons of mass destruction. The Pentagon goes through the motions pretending concern about the environment, holding meetings in far away places like Alaska, Hawaii, where 61 people appear; 15 speak forth; and 7 provide written comments representing 280 million U.S. citizens.

Even the congressional "Millionaire Boys Club" does not feign that kind of representative democracy. The Pentagon does not even care about the speaking and writing concerned citizens. Its Notice of Intent in the Federal Register states the weapons system in question will be used, quote, To defend the forces and territories of the U.S. allies and friends against all classes of ballistic missiles threats in all phases of flights. Which, I suppose, makes the people of the U.S. potential collateral damage.

I imagine the purveyors of the Pentagon portfolio are like the characters in the Beattle's satirical song entitled, "Piggies": Lying, conniving, consuming everything in sight. They never see their evil behavior inflict pain and suffering upon other beings and upon the world. And to get their attention and change their behavior, what they need is a damn

good whacking. Of course, the song is referring to spanking but the Pentagon and spenders can measure its whacking in body counts.

Here in California we analyze public projects and hold them to the test of the California Environmental Quality Act of 1970. When the Pentagon wanted to build a biological nuclear and chemical testing, manufacturing and storage facility at McClellan, UC Davis and Rancho Saco, the community successfully challenged and stopped the bid even before it could be tested by CEQA. The community saw the proverbial writing on the wall. The plan was analyzed. We found it wanting.

The body counts. Yes. Thank you. And I talked about the California Environmental Quality Act, of which I think is great -- well, I think it's good to have an Environmental Quality Act. It's weak but nonetheless it's there. Let me pick up where I was at. Here. Anyway, the community saw the writing on the wall. The plan was analyzed and it was dropped but this -- the same is true of defending BM's. This PEIS reads like a negative declaration.

In case you have not heard, the Cold War is over. This is reason enough for the No Project Alternative CEQA style. It's time for demilitarizing the Pentagon. I'm partial to Helen Caldecott's suggestion that it be converted back to its original design as a hospital. I recommend we just skip the testing, manufacture and storage steps for these weapons systems that are referred to in this EIS and cut to the quick and decommission them all. Take out their fuses and timers and igniters and hire clever chemists to convert their horrible toxins to safe use.

Further, since adults seem to muck things up in the State Department, we should pay and support a coterie of children as ambassadors of peace and reconciliation to all countries on Earth. No more foreign aide. No more foreign debt. The kids will figure it out from there. The spanking should continue upon Pentagon contractors until they change their behaviors. Meanwhile, rescind all Pentagon weapons contracts. No more bucks for bombs. The reason why the Pentagon thinks it needs these weapons systems is because the United States of America has neither learned how not to over consume the planet's resources or stop exploiting human labor. We must become men and women of conscience who believe in and practice trust and respect for one another.

The No Project Alternative, as in CEQA spares us and our planet's ecology while allowing our energies to be spent on truly productive human endeavors. No showstoppers, eh? So this is a show. This PEIS is a non-responsive negative declaration. Thank you very much for your time.

DC_PHO0025

I'm Dr. Leonard Fisher, retired faculty member of medicine at UCLA and volunteer physician at the LA Free Clinic and a member of Physicians for Social Responsibility. I'm one of the groups that drove through the rainstorm this morning to get up here so we could express our concerns about what is going on. I'm going to limit it to the problems related to ground-based interceptors. The most tested but still woefully ill-performing technology to develop to thwart long-range ballistic missile attack is out of the midcourse interceptor.

This weapons system is designed to intercept enemy missiles in space from ground platforms in Fort Greely, Alaska, Vandenberg Air Force Base in Southern California. The chemicals used in solid rocket propellant that would be used to launch the intercept missiles, the test missiles and especially the booster rockets that place related detection communication satellites in space would all use imodium perchlorates as the oxidizing agent in the rocket fuel. The fuel would also contain highly toxic hydrazine compounds and nitrogen oxide. In the news of late, the developmental toxin perchlorate has been found in many of our nation's drinking water sources. This chemical inhibits thyroid hormone creation and release. In low doses, perchlorate is presumed to decrease the intelligence potential of a developing fetus. In cases of more severe exposure, can cause frank retardation. dditionally, once combusted and exposed to air moisture, perchlorates create hydrochloric acid, more commonly known as "acid rain."

Further, rocket launches deliver hydrochloric acid in the upper atmosphere which, in turn, chemically interact with the protective ozone layer. It is therefore fair to assume that an increase in rocket launches may correspondingly bring about additional cases of skin cancer. Rocket fuel needs to be continually replenished. The disposal of solid rocket propellant through washing out, propelling or open burning, open detonation are some of the major sources of perchlorate contamination across the country.

None of these perchlorate-related issues are adequately addressed in the PEIS. I'd like to add one further comment regarding the meetings that have been held. Southern California is bearing a disproportionate impact of missile defense development and its effects on the environment. The midcourse interceptor is being tested and deployed at Vandenberg Air Force Base in Santa Barbara County.

The Airborne Laser is being tested at Edwards Air Force Base in Los Angeles County. The space-based and Airborne Lasers are being developed by Northrop Grumman in the South Bay and San Juan Capistrano. Lockheed Martin, Boeing and Raytheon are deeply involved in developing the midcourse interceptors and other systems. At a minimum, there should be additional hearings near the areas most effected by missile defense developing. There should also be an environmental health evaluation concerning cumulative impacts for military production, testing and deployment of missile defense systems compounded on top of past military use. This evaluation should be done with an eye on disproportionate impacts on low-income communities of color. Thank you.

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Is this better? I'm Philip Coyle. I'm also from Los Angeles. The environmental process described in this PEIS is not believable or trustworthy because the statement read by Mr. Duke tonight is already not being followed. Mr. Duke said if testing failed to show the system worked, the system would not go forward. But as we know, the system is already being deployed even though it has no demonstrative capability to work under realistic conditions. To take a different example, the PEIS says and, I quote, The Airborne Laser is currently the only -- emphasize only -- proposed BMDS element with a weapon using an air platform, closed quotes. However, the PEIS does not discuss another proposed BMDS element that would use air platforms; namely, interceptors fired from aircraft.

With respect to the No Action Alternative already mentioned by others, it does not describe a scenario where no action is taken. Rather, it describes a system where the Missile Defense Agency would continue existing development and deployment unabated under the No Action Alternative. And I quote the PEIS here, Individual systems would continue to be tested but would not be subjected to system integration tests, closed quotes. This is hardly no action and allows for indeterminate missile defense program since -- to go back to quoting the PEIS, There are currently no final fixed architectures and no set operational requirements for the proposed BMDS, closed quotes.

Thus, even if MDA agreed to the No Action Alternative, it would not find its actions constrained for the foreseeable future. And, finally, with respect to space-based interceptors, the PEIS is silent about the fact that missile defense would, for the first time, weaponize space. While space is certainly militarized, it's not yet weaponized; that is, with attack weapons in space and with the chain reaction of a new arms race in space. The PEIS does not adequately address the environmental impacts of the consequences of placing strike weapons in space. Thank you.

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Thank you to everyone who has spoken so far. I think it's been -- I have learned so much and I feel like I really understand a lot more than I did when I came in. There is not very much really that I can add to a lot of the things that have been said because I don't have the particular expertise. I'm a local attorney concerned with human rights and peace. And so one thing I thought I might address is something that was alluded to by several of the speakers and that has to do with the process we're involved in here.

As an attorney, that is something we're always concerned about is process. At first when I first heard about the hearing and when I came here and saw all of the nice exhibits you had put up, my first impulse was this is really cool -- you know, this is really nice and how nice we've all been invited. But now I don't think so anymore because I'm noticing that there were only four locations at all where public testimony has been invited: Virginia, Sacramento, California, Hawaii and Alaska. That seems to me to be not nearly enough public input. That point has already been made.

I would like to talk about Exhibit ES-3, which is part of the Executive Summary. If you want to go along with me, that exhibit shows the effected environment. This is about environment that we're talking about here today. I looked at that to see what the affected environment was. All of the environment that can be affected is divided into nine biomes, as well a broad ocean area and the atmosphere. I went through that and I saw the following. I saw that we're talking about the Arctic regions, North Atlantic Ocean, Pacific Ocean, Alaska, Canada and Greenland. Then some more Arctic regions and also Alaska, deciduous forest and Eastern and North Western U.S. and Europe, Chaparral. That is California Coast, Mediterranean from the Alps to the Sahara Desert, from the Atlantic Ocean to the Caspian Sea. This is a lot of area here. And these are areas that are labeled as "affected areas." Oh, the Grasslands. That is the whole prairie of the Midwest. The desert. Oh, the arid Southwest. New Mexico, Arizona, Utah and the Rocky Mountains, as well as the Alps, Pacific Equatorial Islands, which I don't know. Maybe that is why we're going to be in Hawaii. Northern -- you've got to turn the page. Northern Australia. And then how about the broad ocean area. That has no particular latitudinal range and that's the Pacific, Atlantic and Indian Ocean. And then the really big one, the atmosphere, which is the atmosphere which envelops the entire earth. That looks to me like a global environmental impact.

And it seems to me only fair and some kind of rule that I think is codified in lots of different places that the people that are effected by legislation and -- and programs get to talk about it, get to respond. Well, that is going to be a lot more than the people in the U.S. Even if you say four hearings is enough in the U.S. -- this is a global environmental impact, this Star Wars Program. And, therefore, I'm not impressed with the hearing anymore. I think four is completely minimal. And so I would like to take the remainder of the time, if you would allow me, to make some suggestions of things that maybe other people might want to add, things that we might be able to do and do a little organizing here; which is, first of all, I think it would be entirely appropriate if you -- anybody who knows anyone and has connections, friends on legislation, which I'm a big supporter,

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lawsuits -- I think some lawsuits are called for for the reasons that were explained, which is the Environmental Impact Report is really inadequate and does not -- does not meet basic legal requirements.

I think that would be a very good thing to do. You should get ready for that and -- Colonel -- and another thing too is there are a number of people here representing different organizations, Physicians for Social Responsibility, FCL has -- there is also Friends Committee on National Legislation, different groups and so forth. Different groups. I think really we can get the word out through our emails and so forth about this.

And I'm also concerned about contacts in Europe for those like WILPF, for instance, which is an international organization or any international organization, Greenpeace, whatever, that you belong to because I think that people in Europe, Australia and so forth have a right to know about this and to have the same information that we have. And people may have other ideas. Now, just a little personal note here. My son lives in Southern Switzerland in the Canton of Tacino. He married a woman who is teaching. I'm going to let them know. I saw the Alps are in here. They're in the southern Alps. And I know that when I've gone to visit them, I can tell you those "pace" flags are hanging all over the place. People there really care about peace. They were part of a demonstration in Milan that was humongous. And I think there would be a lot of concern and there should be a lot of concern. I really think it's unfair to put a Star Wars system into place and not allow people who will be affected to weigh in on that matter.

And I guess my final suggestion would be to vote for change of Administration.

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My name is Winnie Detwieler. I'm here on behalf of Sacramento Area Peace Action and our 4,000 plus supporters, both to comment both to comment on the PEIS and register a complaint in which the manner in which the hearing has been scheduled. There's been no widespread publicity in California that we're aware of regarding this hearing today in Sacramento. Is this some sort of the stealth strategy to limit public input on such critical issues. The question is: Can the Draft PEIS be legitimate if there is not adequate notice of the document in the hearings on this matter?

What is most disturbing, however, is that the current Administration is forging ahead with components of the first two interceptors for the BMDS, making a mockery of these hearings. It's even more perplexing that the interceptors were just installed and had not been tested in the system. The tests have been continually postponed and the Pentagon's Chief Weapon Evaluator has said the interceptors may only be capable of hitting their target about 20 percent of the time.

Why is our government spending billions of dollars in risking the beginning of a nuclear arms race on a so-called missile shield with such an abysmal record? The greatest danger we face is not some intercontinental ballistic missile carrying nuclear warheads to our shores; but are reigniting nuclear arms race and motivating countries that fear us to attempt illegal acquisitions of nuclear weapons. They see the technology for our Missile Defense System can also be used offensively against them. Their defense against our military superiority would be to either produce many nuclear ballistic missiles to overwhelm our 20 percent system or to use secret delivery system weapons smuggled into our country or delivered by short-range missiles launched just off shore.

Forging ahead with the missile defense system will create terrible consequences from pollution from rocket launches, space debris and accidents within the system or involving civilians. Other groups are scheduled to testify more comprehensively on this environmental hazard. But I'm emphasizing here all people on Earth, not just Americans, face grave environmental threats from this drive to dominate the world by dominating space.

The environmental pollution may kill us slowly if we don't do it quickly with a nuclear war. But the greatest environmental impact will be to make the entire planet more dangerous to all forms of life and we Americans more vulnerable and not safer. Most Americans consider nuclear war unthinkable; but apparently our leaders in Congress do not. It is astounding to see the turn around on proliferation and new nuclear weapons in this Administration. Will threatening other nations encourage them to cooperate with a non-proliferation treaty? Will the U.S. violations of the treaty persuade other nations to embrace non-proliferation? We think not.

Similarly, the abrogation of the Anti-Ballistic Missile Treaty last year by this Administration in order to pursue this fantasy missile shield will not promote international cooperation on disarmament. We can only conclude that this rush to further

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develop and deploy this ill-conceived missile defense shield is driven by ideology and politics and fueled by the greed for profits from this costly boondoggle. That is what it is, a boondoggle. The leading scientists and Nobel Prize Laureates have condemned this as irrevocable and dangerous to global security. But this Administration rushes headlong into a hasty deployment. The term coined to characterize this drive is a "rush to failure."

In conclusion, we at Sacramento Area Peace Action condemn the Alternatives 1 and 2 with extreme threat proposed on our nation and the world. We would support the No Action Alternative if there had been a legitimate attempt at researching and weighing a true alternative of no action. Such a proposal should have encompassed a suspension of research and development, no testing and no initial deployment. It should have evaluated the cost effectiveness of vigorous pursuit of international cooperation on nuclear disarmament.

As it stands, the No Action Alternative does not meet the requirements of the National Environmental Policy Act. For this reason, we consider the Draft PEIS inadequate and insufficient for proceeding with the BMDS.

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Hello, my name is Jean Bodeau and I have no affiliation with an organization. I'm a professional geologist and engineer and I've worked as an environment consultant in Alaska for almost 20 years. I now work in health care. Some of the work I've done as a consultant is I've managed several million dollars worth of military contracts, mostly for the Air Force. I oppose the entire program on both philosophical and concrete grounds, with specific points as follows:

First, it doesn't address the real threat, i.e., terrorist with low tech devices that could come over borders, by sea, suicide bombers. I understand the Iraqi insurgents now are trying to get more weapons of mass destruction. This project, to me, seems totally divorced from the realities that we're facing as a country and takes funds away from the real threats.

Two, the sequencing on the whole program seems backward. The EIS is late and the project is premature. Furthermore, the technology doesn't appear to work, yet it is already being deployed.

Three, NEPA does not seem, to me, to be a big enough vehicle to evaluate the program. It should include international input because the implications of this project are global. And I noticed on your map out there Antarctica is not included on the map. I'm sure you looked at it but.....

Fourth, the PEIS, with all due respect, I know a lot of work went into it, is -- in my opinion it's crap. I've worked on these things quite a bit and I know that you can manipulate your data, manipulate your analyses to come out with exactly the results you desire. And I think that's what's been done here. It ignores or glosses over potential concerns and it put many other assessments off to future assessment to the site-specific assessments, the tiered impact -- or the tiered assessments that you mentioned.

I noticed on the summary and in the documents, I've looked through those. I got them in the mail and I appreciate those being sent out in advance. There are a huge number no significant impacts listed. And I think that this issue is a big enough and hugely important issue that it deserves more than a cursory analysis of the environment impacts.

I have some more specific concerns, things that the PEIS does not adequately address. Number one, exposure to increased levels of toxic pollutants from a dramatic increase in missile launches. Liquid propellants containing hydrozene, nitrogen tetroxides and other compounds that are highly toxic. In addition, ammonium perchlorate, which is used in solid propellants, it blocks the formation of key thyroid elements that are critical for growth and development, especially in fetuses and children, and this was not considered. Another concern is that the risk to health and safety of DMD missile accidentally shooting down civilian and friendly military aircraft was not considered.

Third, it neglected to look at space debris from high altitude midcourse missile intercepts or destruction of satellites, and it really glossed over potential impacts of debris falling to

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earth. It just wrote them off as being burned up in the atmosphere. Another concern is that it didn't really look at the many rocket launches that are needed to test and deploy and maintain the space interceptors.

Five of the specific points, the program could contribute to the proliferation to the weapons of mass destruction and an arms race in space. The response of other nations to the BMDS has not been considered.

Six, radioactive fallout from intercepted missiles has not been considered. The effects of war are normally excluded from analysis by NEPA; however, this proposed BMDS action is very likely to provoke a worldwide WMV arms race and force other nations to prepare to launch a massive retaliation against the U.S. should war ensue. And I believe that radioactive fallout needs to be looked at and not written off as a no significant impact.

Seven, also missing is an assessment of impacts to the environment, human health and welfare and future generations, which would result from the monstrous financial burden of this program and taking resources away from other critical aspects of our nation.

And, last, the BMDS PEIS does not really include a No Action Alternative. Your No Action Alternative does not include the option of not deploying any of these, there's just dropping the program right now. And I think that we need to have a true No Action Alternative considered as part of this.

I am going to submit additional written comments. Thank you for the opportunity.

DC_PHO0038

Hi. Thanks for having me. My name is Steve Cleary, I'm the Executive Director for the Alaska Public Interest Research Group, my acronym is AKPIRG. That's another acronym for everybody tonight. I, like Jean, am in favor of the No Action Alternative, but would also like a real No Action Alternative, which would save us tens to hundreds of billions of dollars if we didn't deploy the system.

I remember from last time, part of about the radar, somebody from Valdez was worried about that it was going to set off airbags in cars, set off fire extinguishers, some kind of weird effects of the radar, but I didn't see any mention of that in there and I didn't get a chance to read the whole thing. I just read the executive summary. So I would like to hear more about that.

But I think a lot of us are concerned about the integration of all these systems when all the systems aren't here. We hear about the sea-based radar that's going to be swung around and come on up and be sitting outside by Shemya, but we have five missiles in the ground, maybe six by now, and we're going to start deploying that by September, but yet this isn't due until -- you know, the Record of Decision isn't going to be until February, so the integration of the system doesn't seem to have happened, yet it all seems to be going forward and this Programmatic EIS doesn't seem to have a whole lot of effect on that.

So, again, I am here tonight to speak in favor of the No Action Alternative. I do also believe that deployment of the missile defense would spur a global arms race and cause nations to devote resources, simply because we are, to this weaponization of space.

I'm also concerned that we'll be exporting it to non-U.S.A. locations, Canada, United Kingdom and other places who might see us as a world superpower and want to, you know, receive our favors and so they would acquiesce to this system. Specific to Alaska, I have a lot of questions about the Kodiak Launch Complex. I'm really concerned about the aborted launch that happened at Kodiak, I believe it was two years ago November and Kodiak itself is a significant enough population center to be concerned about it, but if we start launching missiles from Fort Greeley, which is near Fairbanks, near Delta Junction, that have to be aborted, there's significant population centers there, not to mention the TransAlaska Pipeline.

Something that was mentioned in the presentation and in the PEIS, it talks about a robust testing program. It mentioned in the PEIS that the test are going to dictate which further things happen. We haven't seen a realistic test yet and that concerns us here in Alaska, particularly when, you know, like I said, an aborted launch could have such a disaster effect on our state.

It's unclear from the PEIS, and I'm looking at Section 2.242, whether or not the Kodiak Launch Complex is going to be a launch test and defensive operational asset or if it's going to launch things into orbit, or if it's just a test center. So it's confusing for the folks on Kodiak and for us here in Alaska what is actually going to happen out on the island.

DC_PHO0038

It talks about a safety zone that would be established around the laser during activation. This is also in the PEIS, Pages 250 to 254. There's a lot of small plane traffic and a lot of small boat traffic around Kodiak and other places in Alaska. It has us concerned about the laser and its effects on our economy and on the human resources, or humans, I should say, of Alaska.

The hydrozenes that Jean mentioned were the same things that I believe came from when the space shuttle crashed and landed in Texas and there was a very large mobilization to get people not to touch those things. And if that's the same chemical that's going up with each of these launches and potentially coming back down, then those will be grave consequences indeed. A lot of the missile defense system has been sold up here in Alaska for the economic benefits. And I know the Programmatic EIS also takes in social and economic benefits and I could think of a lot better ways for us to spend these hundreds of billions of dollars that will eventually be spent on this system that isn't going to work and is also addressing the least likely treat.

So I thank you for the opportunity to speak in favor of the No Action Alternative. Thanks.

DC_PHO0039

Yes, hello. My name is Greg Garcia, I'm a member of Alaskans for Peace and Justice, as well as No Nukes North. There's just a few brief things I'd like to say about this. I mostly want to comment on it as a policy issue. I realize that, you know, the purpose of this is to take testimony about the actual environmental impact of this and I'm not really all that knowledgeable. I've looked at a lot of the materials about it, about the environmental aspects and, frankly, you know, I'm not probably qualified to interpret a lot of the things that are said there.

However, I do definitely oppose the space-based weapons platform that are mentioned in Alternative 2. Certainly, you know, be opposed to putting weapons in space. I'd like to see something quite a bit less than the No Action Alternative, I'd really like to see something rolled back in a way and dismantling and using these resources, the financial resources that were wasted on this on much more pressing needs in this country.

As many people have mentioned, it does protect us from what's the least likely attack scenario. There's way too many other things going on that are threats where the resources that are being expended here could be used. For example, roughly four percent of the cargo containers coming into the United States from foreign countries are inspected in anyway, and that's mostly just inspecting the paperwork, not even actually doing an actual physical inspection. And we could certainly create a lot of jobs that way, as well as by building this system. So it doesn't seem like a very good cost benefit there.

I feel that this system makes us less safe. In one way by leading to an increased arms race as we have pulled out of the 1972 ABM treaty. I think that was a mistake. By pulling out of that treaty I think we've stimulated China to increase its production of intercontinental ballistic missiles and possibly the spin off there is that India and Pakistan may be increasing their weapons as well in order to have a defense against China.

The idea to dominate space seems to be at the heart of this, that's fairly, clearly spelled out in United Space Command documents and this seems to be kind of a component of that. And it would seem to me that the desire to dominate space is just a new era of colonialism. In conclusion, I feel that this entire system is based on corporate welfare, that the legislative process that takes place in Washington, D.C. seems to be dominated by huge multinational corporations that want to build the system and so they have managed to lobby and provide the funding for the campaigns for the Congress people, Senators and Representatives who have approved for this program to take place, so that they get to become even more fabulously wealthy than they are now by building a system that, frankly, doesn't work. Thank you.

DC_PHO0044

MICHAEL JONES: I have a few comments to make about deficiencies in this, and some of these were deficiencies in previous analyses.

There's no examination of treaty restriction on target launches in this EIS, no quantitative information on the liabilities of rocket boosters. There's some inconsistencies and confusion about cumulative impacts. This EIS estimates 515 launches in a ten-year period, the previous 2003 ground-based missile defense extended test range EIS estimated only 100 in a ten-year period.

There's an egregious error in Exhibit 4-11 on page 4-102. First of all, there's an addition error in the table. The more serious error is that total emissions for the interceptor are given as 115 kilograms, whereas the 2003 EIS for the ground-based interceptor gave the first stage emissions as 15,000 kilograms. So what's given in this EIS is a factor of 100 too small.

Probably the most serious problem is that this document is largely irrelevant.

As the summary in Section 1.2 indicates, environmental analyses have been done for most of the components already. Notable exceptions are sea-based midcourse defense and space weapons, which to my knowledge have not been analyzed.

R&D and testing of most of the components is well underway and decisions have mostly been made

about these systems, including even decisions about the initial deployment of the ground-based midcourse defense and the sea-based midcourse defense.

The No Action Alternative is not seriously considered. It is claimed not to be at the direction of Congress, presumably the 1999 Missile Defense Act. This Act states U.S. policy is to deploy as soon as is technologically possible an effective NMD system, but the EIS has no discussion about NMD effectiveness and whether that criteria is satisfied.

Finally, the spiral development approach seems to preclude any meaningful assessment. The PEIS could make an useful contribution by analyzing how to judge the effectiveness of the missile defense with no specified architecture and no operational requirements.

Thank you.

DC_PHO0045

ELAYNE POOL: I have a letter that's been signed by 36 people and myself and I would like to read that to you, please.

We support a real No Action Alternative to the deployment of a missiles defense system. This means no further testing, development or deployment.

Deployment of such a system threatens a new nuclear arms race, puts the global environment at risk, and does not improve the security of the United States.

Deployment of a missile defense system will increase the likelihood of a nuclear catastrophe. It impels Russia to maintain a larger nuclear arsenal on high alert than it otherwise would.

Deployment also drives China to deploy a larger arsenal. The impact of a nuclear war, whether accidental or intentional, would dwarf any other environmental nightmare one can envision.

Moreover, the system does not improve our security. So far it has yet to be tested in realistic

conditions and would be ineffective against an attack.

While in the future the capabilities of this system can be expanded at great expense, these developments are likely to be made useless by the newly improved weapons and countermeasures of potential adversaries.

Finally, the $10 billion a year being spent on missile defense should be spent on measures that are more effective and environmentally sound. One example is the program to secure stockpiles of nuclear weapons material in the former Soviet Union and other countries.

The testing, development, and deployment of the missile defense system should be halted, given that the system leads to environmental harm and potentially to environmental devastation and does so without improving the security of the United States.

Finally, I'd like to read a statement, and I wonder if you know who said it. These words certainly apply to this costly system that is untested and will endanger mankind further.

"Every gun that is made, every warship launched, every rocket fired, signifies in the final sense, a theft from those who hunger and are not fed, those who are cold and are not clothed.

"The world in arms is not spending money

alone. It is spending the sweat of its laborers, the genius of its scientists, the hopes of its children.

"This is not a way of life at all, in any true sense. Under the cloud of threatening war, it is humanity hanging from a cross of iron."

That was said by Dwight Eisenhower, Five Star General of the U.S. Army and the United States President.

DC_PHO0046

KYLE KAJIHIRO: Aloha. I am Kyle Kajihiro. Thank you for this opportunity to testify. I am representing the American Friends Service Committee this evening, Hawaii area program, and we're opposed to the Ballistic Missile Defense System completely.

I think that you have inadequate alternatives. You only have three alternatives and there ought to be a fourth one which includes not deploying, developing the Ballistic Missile Defense System, and actually reducing the scope of existing programs.

That should be considered as a real alternative for considering what is really in the interest of the United States and the world in terms of building a real security environment.

I want to first just go back to the question of the process being flawed so it can get on the record.

Again, I think that these processes have typically discouraged public participation. Whether that's by design or just by negligence, I think that it needs to be noted that there haven't been adequate efforts to reach out to the public, to provide accessible venues and opportunities for people to testify.

As I said earlier, as Terri Kekoolani said earlier, Hawaiian translation is essential, the native

Hawaiian language, Olelo Hawaii, is one of the official languages of Hawaii, and that should be honored in these proceedings so that when Hawaiian words are expressed, they are captured correctly and not noted as inaudible or unintelligible, which is often the case.

Second, the question of native Hawaiian culture being an oral tradition, it's very important that you provide opportunities for people to give live testimony where they can look you in the eye and express what they are feeling.

When you say that often written testimony or e-mail testimony is adequate, you effectively discriminate against a whole group of people who are actually one of the groups that are disadvantaged and should be considered as part of the environmental justice analysis of your Environmental Impact Statement.

The missile defense program we believe violates international treaties and is destabilizing in this global environment. As others have said, it will increase the likelihood of nuclear catastrophe by creating nuclear rivalries and forcing other countries to build up their arsenal.

In July 2001 the Russian foreign ministry spokesperson, Alexander Yakovenko reacted very angrily to the U.S. missile defense tests over the pacific. He warned that the missile defense

contributes to a situation which "threatens all international treaties in the sphere of nuclear disarmament and nonproliferation which are based on the 1972 Anti-Ballistic Missile Treaty."

On June 13, 2002, George W. Bush unilaterally and without the vote of Congress withdrew the United States from the ABM Treaty.

So I think that if the United States is going to be a leader of the world in terms of establishing policy for peace and democracy, it needs to demonstrate that by its own actions, and instead it's only demonstrated a policy of aggression.

The nuclear posture is now to consider the possible use of limited nuclear strikes. That's a very dangerous step from past nuclear doctrine, and combined with the missile defense system is seen as a threat to many countries around the world.

So I don't think you can separate the missile defense system from the rest of the nuclear doctrine. It has to be considered together. And in that light, missile defense is an offensive weapon, as others have said, to establish U.S. full-spectrum dominance.

So the Programmatic EIS fails to analyze how the proposed BMDS system will affect the international security environment, how will it impact international laws and treaties such as prohibitions on the weaponization of space. And that's one of the explicit options for the Ballistic Missile Defense

System. So that goes against established agreements to keep space for peace.

I want to also speak about the opportunity costs. As someone testified earlier, what we spend on missile defense and other military spending is stealing from the dreams of our children, the potentials of our community.

I want to give you an example of how this would affect us here in the Hawaii, according to the National Priorities Project. Taxpayers in Hawaii will pay 33.1 million for ballistic missile defense in fiscal year 2005.

For the same amount of money, the following could be provided: 11,269 people receiving health care, or 4,426 Head Start places for children, or 17,466 children receiving health care, or 150 affordable housing units, or four new elementary schools, or 9,556 scholarships for university students, or 571 music and arts teachers.

So I say that that needs to be considered. The opportunity costs of ballistic missile defense is one of the impacts that we have to deal with and our children have to deal with, and it needs to be considered in your Environmental Impact Statement, and I didn't see it listed there.

The cumulative impacts analysis I think was very flawed. You said earlier that you would only consider similar types of global actions in comparing

what the cumulative impacts would be, but I think that's a way of effectively ignoring the combined effects of many, many local impacts that occur when you have these programs in many forms around the world. So I think you need to consider all those analyses, the local studies that are being done, that have been done, past, present and future.

And this also includes historical impacts related to colonialism. As others have expressed about the Marshall Islands, the U.S. program there has been devastating for that community. The same is true here in Hawaii for native Hawaiians; the 111 years that the U.S. military has invaded and destroyed Hawaiian land, culture, or denied people the ability to practice. Those also have to be considered as part of the cumulative impacts.

And this gets to the environment justice analysis, which is also flawed and inadequate.

There is an adverse and significant impact on native peoples here in Hawaii, in Greenland, Enewetak in the Marshall Islands, and in other places, Alaska and so forth, and you did not look at how this program has a disparate effect on those peoples, their culture, their resources, and actually their survival. So please consider those.

And, in closing, I urge you to scrap the program. We oppose the ballistic missile defense, it's dangerous, it's wasteful, and the world will be much better off without it. Thank you.

(Applause.)

To add a little levity here to this program: It's been documented that the program is -- the missile defense system is easily fooled by decoys which resemble these mylar balloons in space, and because there's been so much, I think, misinformation or incorrect information about what the program actually is, we wanted to present you with this testimony that sort of documents some of the effects.

DC_PHO0047

ELMA COLEMAN: I'm from the Marshall Islands.

(Applause.)

MR. BONNER: Yes, absolutely.

ELMA COLEMAN: (Speaking Marshallese.)

51 years since the nuclear Bravo exposed the people of Marshall Islands to nuclear fallout.

(Speaking Marshallese.)

The people did not know what was happening. They didn't know how to deal with the nuclear fallout.

(Speaking Marshallese.)

Are they aware of what would they do if there's any accident with the missile testing?

(Speaking Marshallese.)

Conduct one hearing in the Marshall Islands. After all, that's where the missile testing is taking place.

(Applause.)

How come I'm reading here that the request was given to have the hearing posed or made on Kauai, Maui, and the Marshall Islands, and it was refused? These are the most affected places that are going to be most impacted.

(Speaking Marshallese.)

I don't think that's fair.

DC_PHO0047

(Speaking Marshallese.)

Or at least reassure the people that there's not going to be any accident happening. But we cannot say that there's not going to be any accident. There's no guaranty. No matter what, there's no guaranty. And if something happens, what are the people going to do?

(Speaking Marshallese.)

You know, I'm not sure what kind of chemical you use or you put in a missile testing or in the warhead when you intercept it in space, but all over the years that you have been doing the testing between Kwajalein and Vandenberg, has there been any environmental study of all the debris that has fallen down into the ocean to find out how contaminated the area is and how far spread the contamination is? Has there been anything done like that? And have the people been aware of what has been done or has not been done?

DC_PHO0048

MARTI TOWNSEND: Aloha kakou. My name is Marti. I have a few points to make. The first are mostly legal, because I hope to God this EIS is put through litigation.

First, notice and public hearing were inadequate. Although it's true that NEPA doesn't require them to hold a public hearing, it does require that the notice be on par with the extent of the program. And as they've clearly shown on their beautiful screen, this is supposed to have worldwide effect, yet we're only having, what, thirty of us here? I mean, this is affecting not only all of Hawaii, but all of the pacific and all of the entire world, and where was this hearing noticed in? Was it noticed on TV? Where did you guys hear about it? Word of mouth. I don't think notice was sufficient in this case, especially given the extent of this project.

In addition, as everyone has stated, there should be more hearings held. The three on the continent and the one here are just not sufficient.

In addition, the alternatives analysis is also inadequate. NEPA requires the alternatives to be considered, including the No Action Alternative, as has already been stated. That is sorely inadequate. But, in addition, you'll notice from reading the two alternatives, they're simply variations on a theme, they're one and the same thing.

DC_PHO0048

And the reason for this, the reason why this is justified is because they're getting off on a technicality, because they stated that the purpose of this program or this project is to implement a Ballistic Missile Defense System. It's misleading, because really what this project is supposed to do, like the overriding principle, is to provide for the defense of the United States.

If you're going to provide for the defense of the United States, you need to talk about what are some real practical things that we should do or that Americans should do to protect themselves, and that includes, you know, not going over to other countries and blowing them up. We're actually talking about real diplomacy.

Unfortunately, this EIS doesn't do that, so, therefore, it's inadequate. I'm hoping that through litigation the technicality, like, can really narrowly define the purpose so that you don't have to do an extensive alternatives analysis, will end with this PEIS.

Also, the cumulative impact analysis is also inadequate. NEPA requires that past, present, and future activities that may incrementally add up to accumulative impact on an area be assessed, but this PEIS is flawed for several reasons. First, it doesn't really consider past projects in the cumulative impact analysis. It says something to the effect of, well,

there are things that had gone through NEPA assessment before and so we're not considering those now.

This is obviously logically flawed. I mean, the EISs that we've gone through before, had any of them ever dreamed that there would be a missile defense thing shot from space? I mean, let's look at the Striker IS. We're all familiar with that. Does that mention at all anywhere ballistic missiles? No.

Okay. So clearly relying on a NEPA document published before this day is not going to give us an adequate analysis of whether it's a cumulative impact. In fact, there's a heck of a lot going on here caused by the military that never went through NEPA analysis.

Let's talk about use of Agent Orange on Oahu, okay? There's lots that needs to be assessed here, and to just cop out and say, well, there was once a NEPA document done, when we never even dreamed of shooting missiles from space, that's just not going to cut it.

In addition, they also put this really interesting limitation on it that I've never seen before in an EIS, and I've read quite a few myself. It says, well, because this has a national and international nature to the impact of the ballistic missiles, they were only going to consider national/ international cumulative impacts. That means only something that affects the entire continent, only if

it affects the entire world. So we're not going to look at the unique situation of Hawaii. And what we are having to go through is the increasing militarization of Hawaii, and that's not sufficient.

I mean, to really consider the cumulative impacts of this PEIS, we need to talk about things that are in the areas that are likely to be affected and likely to be caused harm.

In addition, the PEIS -- I guess I covered that point. Okay.

So the two main points are that past analysis is needed, we need to look at previous things that have been done in Hawaii and across the country or across the United States that have caused impacts, and then also the effect of not just national/ international impacts, but also of local impacts.

The rest of what I have to say is really like a wake-up call for people. Like I said, there's only what, thirty of us, maybe forty? This thing is huge. We need to not let them take advantage of our trust, take advantage of our naivety. We need to get out there and talk to every person you know about this. This is huge. The only way that we're going to counteract this is not through these public hearings -- they are a great way to educate ourselves and connect with each other -- but what we need to do is talk to your Congress people, talk to your neighbors, vote, demonstrate, write letters to the editor,

educate people about what they want to do.

Crap is going to fall from the sky. It's going to set on fire and it's going to land on the ground. They're going to be shooting hazardous materials from space. And CERCLA is mentioned once in the EIS. CERCLA is the hazardous waste law. Want to know where it's mentioned? In the table of contents, that's it. It's only mentioned in that list where they say, these are what all the abbreviations are. It's not anywhere else in the document.

So we need to organize. They really are playing on our trust and our ignorance about this process. They say stuff like, well, there's no unavoidable adverse impacts. I think Marty said something to the effect there's no, like, showstopper environmental impacts. Well, that's because they are relying on a thing called best management practices.

Best management practices says that given whatever project you're involved in, you use the industry standard to make sure that you are abiding by whatever everybody else is doing. So if you're running a power plant, you look at what other power plants are doing and make sure you are doing the best thing environmentally for that.

Well, let's see. Who else is shooting missiles from space? Don't know. There's only one. Okay. So best management practices is whatever they

want them to be.

So there are going to be unavoidable adverse impacts. We can't let them string us along like that. They use these words and these technical terms and people don't know what they mean. This stuff is just filled with technical jargon and we're forced to read 500 pages and make an informed decision about something.

They are using this process to sort of tell people who don't think we have the time to get involved because we're too busy being employed and trying to raise a family, they use this process to cover up the fact that we aren't really making an informed decision, that people are being taken advantage of, and the law is being tweaked and used to their advantage to disempower us.

So although they may meet technical requirements of NEPA, we need to make people aware of the fact that they are not meeting the real requirements of NEPA and we aren't making an informed decision. Thank you.

JULIA ESTRELLA: Good evening. My name is Julia Estrella and I serve on the National Committee of the United Church of Christ which deals with justice for Micronesians. It is with that hat on that I testify before your committee tonight.

As a member of the Micronesian Pronouncement Implementation Committee of the United Church of Christ, I have become aware of how the United States tested 67 nuclear bombs in the Marshall Islands from 1946 to 1958.

Now the United States' missile plan includes missile launches from Vandenberg Air Force in California to the lagoons of the Marshall Islands.

I am not a scientist, although my husband was a physicist, and therefore I do not understand all the scientific terminology that they use in the EIS. In fact, as I was listening to all three of you make your presentation, I felt like I was an alien from another planet, as though -- I mean, we were totally in a different stratosphere as far as I was concerned. I felt pretty overwhelmed by your presentation and, actually, I began to feel like how the Marshallese folk must have felt when the military approached them and asked them to give up Bikini. I felt like you were saying this is good for mankind, trust us, we know what we're doing, and feeling overwhelmed. You know, I felt like I was being fooled. I felt like the decisions were already being made. How can you say no

when probably the decisions are already made to move in this direction?

Anyway, I feel that I was glad to hear the previous speakers all talk about cumulative effects, because I think that is one of the weakest areas of your EIS. The cumulative effects on the Marshallese people, for example, who have already been exposed to so much nuclear poison and now you want to add more toxic waste into their lagoons. And the cumulation, the additive factors, I think you have not even touched on how this is going to impact a group of people that have already suffered enough for us Americans.

So I think that if we're going to shoot at all, we should be shooting these missiles on the coast of Washington, D.C. I think that would be more fair in terms of cumulative effects on a group of people who have already taken too much of our nuclear and our toxic waste into the lagoons.

Also, I feel that instead of spending billions on an expanded missile defense program, I, like Kyle from AFSC, feel we should spend those billions on the needs of the people.

I work with people who live in public housing, as an organizer, and I see the people on a day-to-day basis who don't have enough food to eat, enough supplies for schools, who are on a survival basis. And here we're speaking about spending all

these billions of dollars for what? You know, to me it's such a big waste of money, a big boondoggle. And who is benefitting from it? All the big defense contractors like Rayon and all these multinational corporations. These are big bucks for the military contractors.

It's not fair, it's not just, and I think we need to realize that. Even in the EIS, we need to state something more clearly about the social impacts and what it does to ordinary people who do not benefit from these kinds of programs. The rich are already getting richer. Why put more money into the pockets of these defense contractors?

Then, finally, I wanted to say that in your EIS I think you're misleading all of us by putting No Action as a third alternative. I think you need to be more honest and state specifically that No Action means to keep on testing as is without the integration.

I think that some of the people here felt like No Action meant that you were going to start dismantling the missile defense system, which, of course, should have been stated as another alternative, which you didn't even give us a chance to put down.

At first I was going to put No Action, and then I read where it says continue testing as is. And so please do not mislead us. Please state what you're really meaning when you say that's a third

alternative. And please give us another alternative which says stop Star Wars, dismantle the missile defense system, start helping the people who really need the help, and let's bring peace instead of more destruction. Because as you were talking, you talked about destroy this and intervene here, and we don't need more destruction. So in the EIS please focus on other than destruction.

Thank you.

RON FUJIYOSHI: My name is Ronald Susumo Fujiyoshi. I come here as a member of U.S. Japan Committee for Racial Justice. I also served as a missionary of the United Church of Christ for 29 years. Twenty of the years were in Asia. And after that, part of the time was in the pacific.

A friend of mine, Dr. Kosuki Koyama wrote a book called "Water Buffalo Theology," and one of the chapters of the book was called "Gun and Ointment." He said that western imperialism has gone and colonized the world, and in many cases the missionaries were the ointment that went along with the gun. And since I was a missionary, I wanted to state very clearly that we need to cut the ties of the missionaries, the ointment that goes with the gun, and to state very clearly that we oppose any gun.

So that's part of the reason why I am here today. I think the EIS or the Draft EIS that I read is just a shibai. "Shibai" in Japanese is something like a show, just a show or a play or a deception. You know, all of the nice PR stuff that is written and says there's no impact, we know there's an impact because we know Marshallese people are dying of cancer. We know that the Department of Energy is cutting back the funds that are monitoring the Marshallese from the atolls of Rongelap and Utrik because of the expense and the war in Iraq.

These are the ones who were used as guinea

pigs in the 67 nuclear and atomic tests. The cumulative effect of the 67 nuclear and atomic tests were 7,000 times the impact of the Hiroshima A bomb. You can't imagine what 7,000 times Hiroshima is.

Seiji talked about coming from Hiroshima, so he has seen firsthand the effect of just one A bomb on Hiroshima, and so it's beyond the scope of us to imagine what 7,000 times that would be.

I went to the Marshall Islands maybe about five times when I spent time there, and the last time I went was on March 1st of last year, which was the 50th anniversary of the Bravo test, and we were there with the survivors and heard their stories of that one Bravo test, which was the first U.S. hydrogen bomb tested. And so we heard the stories of what happened in the tests. And to me it's very hard for the Marshallese people to believe the U.S. military, especially in cases like the EIS, because, as Elma explained, if you looked at the video called "Half Life," you would see that there was a U.S. Commodore Wyett who went and spoke to the Bikini Marshall Islanders after they came out of church on Sunday and he made a statement that you can see for yourself in here that they're going to harness this destructive nuclear force for the good of mankind, and he asked them, will you give permission to move off the island so we can do this for the sake of all mankind. And their response was something like, well, if it is the

will of God, we will do it. And so he made the statement, and I can't forget his statement, well, if it is the will of God, it must be good.

You know, and that kind of a shibai or deception has gone down through the ages.

Many of you know that in 1972 Secretary of State Henry Kissinger confirmed U.S. thinking that American military interests must prevail over the self-determination of the Micronesian people when he casually remarked: "There are only 9,000 people there. Who gives a damn?" This was quoted by former Secretary of Interior Hickel.

So I think if you are Marshallese, are you going to believe an EIS statement that says no impact? I think it's very hard to convince them that there is.

I think those of us who are from Asian or Pacific background, we have a theology that all life is related. What is related is a harmony of life, so that what you do to one thing, affects everything else. But it's only a western kind of thinking that compartmentalizes everything and says, this spot will have no impact, this spot will have no impact, this spot will have no significant impact, this spot won't have, and then they go around the whole thing and say, therefore, there's no significant impact. Well, we know that's erroneous, because the whole understanding of how everything is interrelated is different from that. And I think we need to point that out to the

people here.

We had Joanne Whipplejuwski (phonetic) of the PST (phonetic) who was the managing editor of the Nation Magazine, went over to the Marshalls and did an in-depth story. And she went to Roy Nomura (phonetic) where some of the top U.S. military scientists are stationed. It's way in a secluded area and many of them are brilliant people because they are tracking the missiles. And they said that this is like a bullet striking a bullet. It's impossible to do. It's impossible to do.

And so what they do actually is they put homing devices in the missiles so that they can have a chance of hitting the missiles. If they didn't have that, there would be no way they're going to do this. So here they're spending billions of dollars on Star Wars when the chances of success are so minute that it's wasting of money.

I think we should be using the money not no make war, but to build friends. And I think what it has to do with, places like the Marshall Islands, is to care for those who are affected by the 67 nuclear and atomic tests, and that's how you keep from having war. I think you build friends.

MR. BONNER: Could you finish up, Mr. Fujiyoshi, or come back?

RON FUJIYOSHI: Okay. I think what is happening is there's no transparency. So much of the things are done in secret that we don't know what is

really going on.

I was arrested twice on Kauai, PMRF, when we tried to oppose the missiles being fired from Kauai to Kwajalein. Why? Because pacific people are now firing on pacific people. And so it's being fired from a burial site on Kauai. And one of the things we found out in one of the times we got arrested is that foreign, other countries, are using missiles to test their own missiles, too. And what do they use in the payload, that was secret. We couldn't find out what was it.

So all of the things that we're doing, we're trying to guess, because we don't know. They're asking us to believe them when there's no transparency. And we need to find out what is really going on.

For example, I read all of the material out there. I don't even see the word "depleted uranium." And depleted uranium is so crucial even right now, what is happening in Iraq or elsewhere, you know, people, even our own soldiers that went in Iraq in the first war, you know, were affected by that. I went to Vieques, and we know the effect of depleted uranium upon the people there.

So if they're not even mentioning depleted uranium in the material on here, then what else are they keeping from us? I think we have a hard time believing that what is being done is on good faith.

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Finally, I think if it's true that the Missile Defense Agency refused to have public meetings on Kauai where PMRF is and in the Marshall Islands, to me that's a very deep flaw. That's something that needs to be corrected. So I support stopping of Star Wars. Thank you.

DC_PHO0051
TERRI KEKOOLANI: Aloha kakou. Kala mai ia'u.

I'm going to turn my back to you folks. I want to talk to these guys.

I just want to make a few comments. First of all, the first comment I want to make has to do with the process. It is very deeply flawed. If what you are planning goes through, then obviously all islands will be impacted. Therefore, to properly inform our people here in Hawaii, you must have all people from all islands being fully informed, which would include the Big Island, Maui, Molokai, Lanai, Ni'ihau, and Kauai.

And it's amazing to me that you don't have a meeting scheduled in Kauai with almost half of an island impacted by the missile range facility there.

Also, just alone coming on Oahu, you're having a meeting in a very small hotel, in a small room. The capacity of the room is sixty people. And so what it looks like is that you're kind of hiding, and that you are not looking for a way to actually get a lot of people to participate in this process.

So what you're doing is actually minimizing the input of people, but you sure are maximizing the hardware that's going into this plan of yours. So I think this is a very, very, big flaw.

Also I would like to say that I just returned from a visit on the island of Ka-ho'olawe and I mentioned to people who have been visiting from

Kauai on the island that this hearing was taking place here on Oahu, and they didn't know about it. I don't know if you guys know how much it costs to get from Kauai to Oahu, but it takes some money, and our people don't have that kind of money. So it says something about you. It says something about how you folks think, that you don't have our people included in this process.

The second thing that I would like to talk about is five minutes. How long did it take you to put this study together? You all only give us five minutes to comment. I don't understand that.

The other thing is, that's not island style. It takes us maybe kind of like a couple of hours just to say hello, just to get to know you. Like who are you, where you from, why are you here, what's on your mind, what do you want to do? What is going to happen with the plans that you are going to do to us? How is it going to impact us? That takes a long time. I mean, come on.

The other thing is, and people have already commented that you don't have any person here that can translate our language. And I'm glad Ms. Coleman spoke to you in Marshallese. You need to do your homework. Before you come to the islands, you should know what the people speak.

Then I just want to continue with just a few more comments. My name is Terri Kekoolani. I'm a member of Ohana Koa, a Nuclear Free and Independent

Pacific. So on behalf of Ohana Koa I would like to say that we are absolutely against Star Wars, and that means that we would like to see the ending of all testing, development, and deployment of a Ballistic Missile Defense System.

Deployment of the Star Wars program threatens a new nuclear arms race, puts the global environment at risk, and undermines the security of the United States as well, and undermines the security of all people.

Also, Star Wars fuels the nuclear arms race. Deployment will increase the likelihood of a nuclear catastrophe. BMDS greatly increases tensions between the world's nuclear powers.

On June 13th, 2002, George W. Bush unilaterally and without a vote of Congress withdrew the United States from the Anti-Ballistic Missile Treaty, once a cornerstone of arms control. We denounced that unilateral action.

Also, Ohana Koa believes that Star Wars will have a significant adverse impact on native Hawaiians, our Marshall Island brothers and sisters, the Enewetaks, and other indigenous peoples; and that the Programmatic Environmental Impact Statement fails to consider these impacts.

Hawaiian burials and sacred sites are desecrated by the missile launches and Star Wars facilities, while cultural practices and subsistence

access rights are denied due to base security measures.

That is already taking place right now on Kauai. You folks have missile launching pads over there on top of an ancient burial ground. It's called Nohili. It is a crime. It's a crime.

And also there are now people being denied access to beach fronts that have traditionally always been accessible by our people.

So, anyway, on behalf of Ohana Koa, a Nuclear Free and Independent Pacific, we are totally against the Star Wars and want to make that very clear. Mahalo.

IKAIKA HUSSEY: Aloha kakou.

(Speaking in Hawaiian.)

In addition to my own opposition to the proposed ballistic defense system, I come here with words from people who were not offered the opportunity to testify this evening because there was no hearing on the island where they reside and where the impacts will take place.

I'd like to begin with offering the testimony of Mr. Jumble (phonetic) Kalaniole Fu who is a fisherman, commercial fisherman, in a family-owned business on the island of Kauai. He experiences on a regular basis the militarization of his island. He witnesses the missiles leaving Pole Hale. He witnesses the missiles flying up out of the ocean.

He is told that he can't fish in certain areas because of military work that's being done.

He's also very concerned because he's seen it for so long. He talks about 18 years of the people of Kauai constantly being told and being exposed to the Star Wars program to the point where they have become desensitized to it.

He's concerned about the effects that it has on his family. He's spoken to me about the fact that there is no research being conducted to ascertain health effects on the people of Kauai, about the propellants and all those things.

He is also very concerned simply because

of the very dangerous things that we're talking about here. We're talking about missiles. A missile has no function but to be a weapon, unless you put a person into it and they're going to explore outer space. Even in that case there's a probability that there's imperial notions at hand. But what we're talking about here are very dangerous things, and he is concerned about the possible dangers that might come upon him and his family and his people on Kauai.

He has seen missiles that misfired or missed their target and destroyed or -- apparently a missile hit another boat, another American vessel. And he doesn't want to see that happen either to the American military or to his own family. So that was his concern.

I also would like to relate the testimony of Mr. Wilfred who e-mailed me from Canada, and obviously there's no hearing in Canada, but he is very concerned because he knows that the proposed American military expansion, the full-spectrum dominance that we're talking about here, he is concerned about the effects that will have on him and his people in Canada.

He is concerned that it will spark a new arms race. He also mentioned to me that 70 percent of the people in Canada, of people polled in Canada, opposed the Ballistic Missile Defense System, so if that's an indication.

Since 1893, and actually before then, America and the greed of America and also the greed of other European countries, we've experienced that greed through military incursion consistently. American businessmen, European businessmen who wanted to set up shop in Hawaii and sell sandalwood and do whaling, and sell sugar and pineapples, the way that they were able to fulfill their avarice was by calling on the military of their countries to come and support them in their desire for Hawaiian land.

All the way through 1848 to the Mahele and then past the Mahele to 1893 we've had constant military invasions from the outside, people wanting our land for their purposes.

Since 1893 American military has only procreated in Hawaii. It's ironic, I know. And the guns that were pointed at the palace have multiplied, and now we're talking about missiles. And I can't bear the thought of my family and my family's land being part of anyone's desire for empire.

I have no desire for empire personally. I have no desire for dominating anyone. So I can't even fathom the idea of full-spectrum dominance. It seems absolutely inhumane, and I don't think that it is something that you folks or the people of America, people of the United States of America have innate to them. I don't believe that there's something that's genetic about Americans that says that they will try to promulgate empire. So I can only hope for the

emergence of humanity in the United States, and the toppling of a regime that will only promote dominance of other peoples.

(Applause.)

Finally, I would like also to present the testimony of 1,330 people who signed petitions opposing the expansion of military in Hawaii. And these people need to be included in the process. They need to be notified of the Record of Decision. Thank you.

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DR. FRED DODGE: Aloha kakou.

AUDIENCE: Aloha.

DR. FRED DODGE: My name is Fred Dodge and I'm a physician, a family practitioner. I'm happy to see two other family practitioners testifying today. We take seriously our role in trying to use preventive medicine in treating communities. I'm also a member of PSR, Physicians for Social Responsibility, and IPPNW stands for International Physicians for the Prevention of Nuclear War, and I also am a member of other organizations. I'm not here representing any of them officially. I speak for myself.

I want to add my voice to those who said that the process is flawed. You really need to hold hearings on Kauai, other places also, but especially Kauai where the Pacific Missile Range Facility is located, who are really greatly impacted by this. And I, too, have friends on Kauai who didn't know about it and want the opportunity to testify.

The Ballistic Missile Defense System, let's just call it Star Wars, everybody seems to know it by Star Wars, is really a part of our warfare state. A lot of people criticize the welfare state mentality, but we really have more of a warfare state mentality now more than ever.

(Applause.)

I think to those who have examined this whole system, it really has -- I mean, it's put

forth as a defensive system, but it really has a great deal of offensive capabilities, and is certainly seen that way by other nuclear powers, especially Russia and China.

I believe it to be dangerous to humans and other living things, and, therefore, I'm certainly against it.

I also question the conclusions of the PEIS in that alternatives that have been mentioned in the past aren't included. I won't go into that except I support those. The lack of detail on cumulative effects is a major defect. And I think the lack of environmental and racial justice needs to be addressed more fully certainly.

And after saying all this, believing it, I agree with Ron Fujiyoshi that it's shibai, this whole thing is something you just sort of go through, because it's going to get approved. But yet we must speak out.

Ghandi has said you have to speak truth to power, and certainly you guys have the power or you represent the government with the power, but we must speak out.

It seems to me that instead of threats from missiles, there's a lot more threats from the suitcase A bombs the U.S. had and then Russia developed the backpack. These are portable A bombs. The horrific thing about it is that the sources that I have read and listened to and so on say that a lot of

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these are not accounted for in Russia during the changeover, they're missing. Where are they? I mean, they're the things that can be brought into the U.S.

I don't know how many people are aware of the fact that about a month after 9/11 the U.S. received reports that one of these portable A bombs was somewhere in New York City.

Fortunately it turned out that this was not an accurate report, like many of our intelligence, it was not correct, but it's interesting to note that Mayor Guilliano was not notified of this at the time and was extremely angry when he found out that this had happened. And apparently there was no way, if that were to happen, to find it. That's a real threat, much more so.

The other thing that I want to mention is that all the information that I've read, mostly from independent scientists, says that the Star Wars project is very likely to fail. Originally the PSR, the Physicians for Social Responsibility, had taken up on that there was -- originally they said there would be six percent chance that a missile could get through, especially the multiple warhead type, and so they gave every member of Congress an umbrella with holes in the umbrella amounting to 6 percent of the umbrella surface. It won't keep you dry.

It's also extremely wasteful, and I think that's been addressed here today. It's bound to

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escalate the arms race.

I had a letter from the late Patsy Mink, representative from Hawaii, and I'll quote what she told me at the time. This is already three years ago. But she said: The National Missile Defense System has the potential to destabilize our relationship with other nuclear powers and will violate the Anti-Ballistic Missile Treaty, which was then in effect. And, as people have stated, our present president has withdrawn us. And certainly we question whether that withdrawal by the president, without congressional support, is legal.

She goes on to say: We should not deploy a system if we don't know whether it will work, which violates our treaty obligations and escalates deployment of nuclear weapons by potential adversaries. In other words, they see it as offense and they're going to be building up. And other people have stated the same thing.

So where are we at? In my opinion, we don't need it. The world certainly doesn't need it. The project should be abandoned. We could save billions. We could even use it for some human needs, such as 45 million people who don't have health insurance in the United States, for instance. This is where I come from.

I also was going to quote President Eisenhower, but that's been so eloquently quoted earlier.

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I'll just say that if there's any way possible to do some of those other alternatives, at least put this on hold, if not scrap it, I think that would be the way to go. Thank you very much.

(Applause.)

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BALLISTIC MISSILE DEFENSE SYSTEM
DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

COMMENTS SUBMITTED ON BEHALF OF THE LAWYERS ALLIANCE FOR WORLD SECURITY, OCTOBER 14, 2004

One October 13, 2003 the Lawyers Alliance for World Security (LAWS) and the Physiciains for Social Responsibility (PSR) filed comments on the draft Environmental Assessment and Finding of No Significant Impact (FONSI) for the Ground-Based Midcourse Defense (GMD) Initial Defensive Operations Capability (IDOC) at Vandenberg Air Force Base. The thrust of the LAWS/PSR comments was that the Vandenberg EA did not satisfy the requirements of NEPA on several grounds, hence the limited conclusions drawn in the EA were arbitrary. In an October 24, 2003 letter responding to the LAWS/PSR comments, Mr. Jerry Hubbard, of the MDA Ground-Based Midcourse Defense Joint Program Office in Huntsville, AL stated (1) that many of the issues raised by LAWS/PSR would be analyzed in the PEIS; (2) MDA received unanimous concurrence and approvals from the pertinent regulatory agencies, and (3) "this project is not controversial." The basis for the latter statement was that MDA received only one other comment critical of the Vandenberg EA.

Mr. Hubbard's letter went on to state that – "The VAFB IDOC is a vital national project that will enable the United States to protect its citizens from potential adversaries. Although I cannot elaborate fully regarding these threats and the IDOC capability dur to the highly classified nature of the information, the VAFB IDOC will provide a critical defensive capability for the country that does not currently exist. Its timely completion fulfills President Bush's mandate to achieve an initial defensive capability by September 30, 2004 to provide a vital protection for the nation."

A. The NEPA Standard

In considering whether an agency's action is arbitrary and capricious, a reviewing court must consider whether the agency has taken the requisite "hard look" at the environmental consequences of the proposed action, carefully reviewing the record to ascertain whether the agency decision is founded on a reasoned evaluation of all the relevant factors. The Ninth Circuit in Greenpeace Action v. Franklin, 14 F.3d 1324 (9th Cir. 1982) pointed out that when determining whether a proposal will "significantly" effect the human environment, the agency must consider both the context (e.g. society as a whole, national, the affected region, etc.) and intensity (i.e., the severity of the impact). In evaluating intensity, the Court went on, consideration must be given to the degree to which the effects on the quality of the human environment are likely to be highly controversial; the degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks, and whether the action is related to other actions with cumulatively

significant impacts. Significance cannot be avoided by terming an action temporary, or by breaking it down into small component parts.

Here, MDA has ignored the highly controversial nature of the missile defense program; has, over the years, issued a series of separate environmental analyses on smaller parts of the entire system, so as to avoid the cumulative impact test, and the nature of the proposed layered integrated BMDS program described in this PEIS is so substantially different from earlier iterations that any reliance on many of those earlier environmental analyses is misplaced. They simply will not pass muster. And, as the Ninth Circuit instructed another agency in a case involving a controversial proposal, "... the term 'controversial' refers to cases where a substantial dispute exists as to (the) size,nature, or effect of the major federal action rather than to the existence of opposition to a use." Foundation for North American Wild Sheep v. United States Department of Agriculture, 681 F.2d 1172 (9th Cir. 1982).

The assertion that the missile defense system described in the PEIS will defend the United States now, or by year-end 2004, or really anytime soon, is patently absurd. The system being deployed has no demonstrated capability against a real attack and is missing most of itsmajor elements, including(1) the X-Band radar; (2) the satellite constellations SBIRS-High and SBIRS-Low (the latter now called STSS), and (3) adequate discrimination capability by its exo-atmospheric kill vehicle interceptor, the EKV, which is also missing. The inescapable conclusion is that the Administration is deploying a system that doesn't work and hasn't been adequately tested.

As envisaged by the Administration, the system is to eventually include two satellites (one in high orbit, one in low) to assist in the early detection of missile launches, track missiles and help guide interceptors to their targets. Both satellites have fallen years behind schedule, so until the new radar arrives, the interceptors will have to rely in large part on radar systems that were developed in the 1960s and 1970s. The most important system, in the Aleutians,hasnot been tested for its new role, and, because of the way it is positioned, it would not be able to detect a North Korean launch aimed at Hawaii. Ten interceptors were scheduled to be in place, but currently there are only five or six, and no one knows whether they can hit anything, because they have not yet been tested against targets.

Yet another controversial aspect of the program is its budget. The missile defense budget has doubled in the past four years, and the appropriations for next year is more than ten billion dollars -- about the same as the Army's entire R & D budget, twice the budget of the Bureau of Customs and Border Protection in the Department of Homeland Security, and nearly twice the department's allocation for the Coast Guard. The MDA estimates that the program will cost fifty-three billion dollars through 2009, but it has grossly underestimated costs in the past.

The PEIS at 2-68 states that the alternative of canceling the development of all ballistic missile defense capability development and testing does not meet the need for the proposed action; does not meet the direction of the President and the U.S. Congress, and therefore "will not be analyzed further." One alternative not even mentioned in the PEIS would be to cut the spending in half, to allow the testing of a system that would eventually work against potential adversaries such as North Korea or Iran. Another would be to look at the realistic likelihood that if the US is ever confronted by a nation such as North Korea or Iran with a tested ICBM,

the option of military necessity would be to destroy such an enemy ICBM on its launchpad with precision-guided missiles if an attack seemed imminent. Yet another reason the discarded cancellation option has merit, at least for further analysis, is the statement submitted to the President by forty-nine retired generals and admirals who asked the President to put off the deployment and to transfer the funds to the securing of nuclear facilities and the protection of American ports and borders against the far more immediate dangers of Al Qaeda, rather than pursue a system that may never work against a system that doesn't now exist.

As the former Pentagon weapons evaluator, Philip Coyle, was quoted in the Washington Post on September 29, 2004 lead article on the missile defense program, the idea of deploying while testing – the Administration's current plan – is like building a picket fence, one picket at a time, over several years. As Mr. Coyle pointed out, until the whole thing is complete, such a fence is not much use.

B. The MDA Has Failed to Meet the NEPA Requirement for Considering a Range of Alternatives

The PEIS is defective to the extent that it fails to meet the CEQ guidance on the range of alternatives agencies must consider. Here, the MDA has failed to propose a real no action alternative, and the so-called no action alternative set out at PEIS 2-67 is not a true no action alternative because under it all the individual components of the system would continue to be tested to determine the adequacy of their stand-alone capabilities. Such an alternative could easily have been Alternative 3, but the MDA should also have clearly set out a real no action alternative so that the public could comment on it, instead of being caught in the Catch-22 this PEIS poses. It is difficult not to conclude that the agency's choice of alternatives was dictated by the end result it desired. While there may be portions of the CEQ guidance where reasonable people may differ, surely this is not one of them. And LAWS submits that a reviewing court would find the range of alternatives set out in the PEIS inadequate, in view of all the circumstances.

C. National Security.

The U.S. Supreme Court in Weinberger v. Catholic Action of Hawaii, 454 U.S 139 (1981) held that a NEPA impact statement was not required on the proposed use of facilities to store nuclear weapons. Later cases, however, have elaborated on the restrictions adopted by the Court in Weinberger, and in 1988 the Ninth Circuit noted that NEPA does not have a national defense exception, and that Catholic Action had implicitly rejected this defense. No Gwen Alliance, Inc. v Aldridge, 855 F. 2d 1380 (9th Cir. 1988) Romer v Carlucci, 847 F.2d 445 (8th Cir. 1988) held that federal defense legislation determined the scope of environmental analaysis under NEPA on the proposed deployment of MX missiles to missile silos, and that review of the impact statement on the deployment for compliance with NEPA was justiciable. In other words, using the current vernacular, relying on national security as a shield to preclude an adequate NEPA analysis is not a "slam dunk"defense.

D. Previous Litigation.

On August 28, 2001, the Natural Resources Defense Council, PSR and several other plaintiffs filed a complaint under NEPA against the Secretary of Defense, the Director of the BMDO, and the U.S. Department of Defense for failing to prepare adequate tiered environmental impact statements in view of the massive changes in the program announced by General Kadish in July 2001. The August 2001 Record of Decision, 66 Fed. Reg. 42848, that purportedly implements the NMD Deployment EIS affirms these fundamental changes: "Since the NMD EIS was completed, the Ballistic Missile Defense architecture has evolved into a multi-layered approach that does not distinguish between national and theater threats."

As the plaintiffs noted at p. 19 of the complaint, " There are myriad environmental impacts associated with the activities associated with the new BMD program. These include major impacts from construction of new facilities and testing programs at site in Alaska, Colorado, Hawaii, the Marshall Islands, California, and other possible locations; disruption of unique and pristine ecosystems from activities such as laying communications cable and test launches, which in some cases, like the Kodiak Launch Facility, are located in largely untouched environment that harbors endangered or threatened species; significant deposition of space debris from numerous planned interception tests in low earth orbit, where it can collide with and cripple existing and future satellites; and depositions in the atmosphere of large quantities of ozone-depleting chemicals from the numerous rocket launches required to test and deploy elements of the proposed system."

The lawsuit was subsequently settled, but the fact that it had been filed and that it mentioned space debris focused on a very significant aspect of the proposed program.

E. Space Debris.

LAWS endorses and incorporates by reference the excellent discussion of space debris in the statement prepared by Theresa Hitchins, CDI Vice President, entitled "Missile Defense Agency Fails to Adequately Address Dangers of Orbital Debris to Spacecraft, People,and Objects in Space, the Air, and on the Ground." As Ms.Hitchins makes clear, the PEIS fails to adequately analyze and discuss the possible dangers of debris in space. If the missile defense program has an Achilles heel, this is it. It is inexcusable for the MDA not to have undertaken or provided adequate scientific review of the physics involved in debris creation and re-entry, as well as of the multiple scenarios for missile defense intercepts. The dangers to people, and to objects in the air and on the ground are real, yet the PEIS blithely ignores such dangers. Depending upon the missile trajectory, debris could also be a threat to Canadian citizens, aircraft and ground facilities. As Ms. Hitchens notes, all trajectories to the continental US from North Korea pass over both Canada and Russia, so that both nations are potentially at risk from boost-phase shortfall.

As LAWS and PSR pointed out in their Vandenberg EA comments, "The issues are too important, and the priority accorded this program would suggest to a reviewing court that rather than risk extended delays inherent in legal challenges to the sufficiency of this (PEIS), the MDA would be well advised to take the time and make the effort to prepare a comprehensive (PEIS) that fully meets all the legal requirements of NEPA." That is still good advice. While the PEIS is an improvement in some respects, it remains fatally flawed. LAWS and PSR and others will spell out these fatal flaws in the written comments that are due November 17,2004.

Respectfully submitted,

Leonor Tomero, President
Philip A. Fleming, Past President
John B. Rhinelander, Past President

October 14, 2004

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Written comment on draft Ballistic Missile Defense System (BMDS) Programmatic Environmental Impact Statement (PEIS)

By Victoria Samson
Research Analyst, Center for Defense Information

October 14, 2004

The draft Ballistic Missile Defense System (BMDS) Programmatic Environmental Impact Statement (PEIS), dated Sept. 1, 2004, is supposed to give an objective and thorough assessment of the effects various missile defense architectures would have on the environment. However, it obviously been shaped to give credibility to the Bush administration's continued assertions that the only way the United States can be protected from an ICBM attack is with a heavily tiered system. The draft PEIS dismisses any real concerns about harmful negative consequences from developing such a system and, in doing so, invalidates itself and its conclusions.

To begin with, the so-called "No-action alternative" examined in this document is misleadingly named. It does not detail a scenario where no action is taken. Rather, it describes a system where "the MDA [Missile Defense Agency] would continue existing development and testing of discrete systems as stand-alone missile defense capabilities. Individual systems would continue to be tested but would not be subjected to system integration tests." (p. ES-8) This is hardly no action and allows for an indeterminate amount of missile defense development, since "There are currently no final or fixed architectures and no set operational requirements for the proposed BMDS." (p. 1-9) The way this draft PEIS is structured, even if MDA was limited to the No-action alternative, it would not find its actions very much constrained.

Alternative 2, which includes the usage of space-based interceptors (SBIs), is questionable for many reasons. It looks at the effect of using space-based interceptors in lieu of terrestrial-based ones; however, the BMDS that is repeatedly envisioned by MDA and Pentagon officials is one where targets would be engaged at all stages in their flight, from all types of launch platforms. To look only at the usage of an SBI is to willfully ignore the concept of operations that has been used to justify this massive defense system. The American Physical Society, in its boost-phase intercept study released in July 2003, estimated that a constellation of at least 1000 SBIs would be required to provide a minimal defense against liquid-fuelled ICBMs. Granted, testing would be of a much lesser nature than a complete constellation, but at some point presumably the system would be tested at some fraction of its full strength. This draft PEIS does not take into consideration that possibility.

This draft PEIS also does not look at what would be required to develop a space-based test bed, dismissing the concept as being "too speculative to be analyzed in this PEIS." (p. 2-29) It does not say when such a concept would be analyzed. Finally, this document admits, "If Alternative 2 were selected, additional environmental analysis could be needed as the technologies intended to be used became more defined and robust." (p. 4-

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116) But again, that is what this document is supposed to do: examine the environmental effects of the proposed action. By sweeping it under the nebulous responsibility of future studies, it relieves the MDA of liability of negative consequences stemming from SBIs.

Nowhere is this dismissive attitud ed more clearly than in how the draft PEIS treats debris, orbital and otherwise. Orbital debris is listed as a resource consideration "because of the likelihood of orbital debris occurring from various launch and testing activities and its potential for impact to health and safety and the environment." (p. ES-12) Yet in every case that orbital debris is detailed as resulting from the proposed actions, it is written off as a non-threat to space assets or the terrestrial environment. It is claimed that the orbital debris from booster failure, for example, would be on-orbit for too little time to create damage, and that it would burn up upon re-entry, but even if it didn't, the likelihood of damage is small. (p. ES-21) This same justification is repeated ad nauseum throughout the document. The draft PEIS does admit that the International Space Station (ISS) may be affected by orbital debris, but again downgrades the threat, saying that the ISS could merely do collision avoidance to ensure its safety. (p. ES-39) This no doubt comes as surprise to our partners in the ISS who were unaware that we were planning on weapons systems that very well could destroy our joint effort unless valuable fuel was used to effect a collision avoidance strategy.

This dismissal of the threat of orbital debris to space assets contradicts statements made elsewhere in the draft PEIS. The document discloses that "little advance warning could be given to clear air space" if an SBI had an uncontrolled reentry. (p. 4-121) And, with a nod to the unpredictable, the document says, "Objects reentering may skip off the Earth's atmosphere, similar to a stone skipping across a pond, causing them to impact much farther away than originally predicted." (p. 4-122) Despite this, the document still clings stubbornly to the conclusion that orbital debris would have no significant impact.

The draft PEIS fails to fully address the effects of other types of debris - rocket fragments, fuel, and so forth. Again, it barely scratches the surface of potential harmful consequences that could plausibly result from the alternatives listed, and again, it immediately dismisses the few consequences that are divulged. Debris that could fall into the ocean "would become diluted and would cease to be of concern." (p. 4-51) Debris that survived reentry is not to be worried about, as it would fall into a pre-established footprint, and even if it didn't, "Debris is more likely to terminate in water than on land because water covers 75 percent of the Earth's surface." (p. 4-119) Debris from spills or intercepts in the air is assumed to dissipate before it hit the ground. (p. 4-24)

Yet this is making a real leap of faith in how these actions wou ent, and doing so in a manner that precludes any real assessment of ences could occur. The treatment of the Airborne Laser (ABL) is indicative of this attitude. The draft PEIS says that should the ABL be not able to land at "an appropriate location," its fuel and laser chemicals may have to be jettisoned, but this would be at a minimum altitude of 15,000 feet and thus "would be diluted in the atmosphere." (p. 4-24) And if there was an accidental fire on the ABL, "the liquid and solid laser chemicals would be

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consumed or contained." (p. 4-34) These laser chemicals include hydrogen peroxide, ammonia, chlorine, helium, and iodine, according to the document. (p. 4-24) No explanation is given as to what would happen should the ABL jettison its chemicals at a lower altitude than 15,000 feet, nor how exactly the fire would contain all chemicals. The draft PEIS makes these reassuring statements with no solid evidence to back them up.

Another issue that is raised and not explored fully is the testing and deployment of missile defense systems abroad, or OCONUS as it is referred to here. The document asserts, "MDA may also develop test beds in other areas such as the Atlantic Ocean, Gulf of Mexico, or outside the continental U.S. to support testing of BMDS components in those areas." (p. 2-28) But it does not say how this would occur, only that "Because NEPA and other environmental laws generally do not apply to OCONUS activities, various EOs and other DoD directives and instructions have been implemented." (p. 4-111) However, nothing specific has been given on how these laws were implemented; rather, the draft PEIS directs the reader to Appendix G, which is a long listing of international treaties and does not explicitly state how the missile defense systems fit into these commitments. Given how unpopular missile defense is amongst the Canadian, British, and Greenlandic publics – the three countries that are the nearest to being incorporated into the BMDS – this should be explained further.

Finally, the alternatives considered but not carried forward are deliberately chosen to showcase the BMDS systems that the Bush administration has been pushing for in the best light possible. The first one is to cancel development of BMD capabilities, which is explained as being an alternative that "would rely upon diplomatic and military measures to deter missile threats against the U.S." (p. 2-68) This is exactly what has kept the United States safe from attack to date, and yet it is summarily dismissed out of hand. The other alternative is to focus on a single- or two-platform BMDS. But, per MDA threat assessments that are not given but merely referred to, it has decided that "an effective missile defense should include components based on at least the land, sea, and air," so a more limited missile defense system simply would not do. (p. 2-68)

This draft PEIS does not fully examine the actual consequences that could very well result from developing and testing a tiered missile defense system. By deliberately rejecting any and all negative effects, it goes against what is legally required of the NEPA process.

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Ballistic Missile Defense System
Draft Programmatic Environmental Impact Statement

Missile Defense Agency Fails to Adequately Address Dangers of Orbital Debris to Objects and People in Space, in the Air and on the Ground

Comments Submitted to the Department of Defense Missile Defense Agency

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Introduction

On Sept. 1, 2004, the Pentagon's Missile Defense Agency (MDA) released its legally required Draft Programmatic Environmental Impact Statement (PEIS) on the testing and employment of its future ballistic missile defense system. The PEIS, however, dramatically fails to address the potential dangers (both to space-based objects and those on the Earth) from space debris that MDA admits will be created by testing or use of ballistic missile interceptors. The PEIS states (p. ES-33): "Proposed BMDS space-based sensor activities would be expected to produce small quantities of debris, primarily explosive bolts and small pieces of hardware. It may be possible for debris from an exoatmospheric intercept to become orbital debris. However, because the majority of the BMDS activities would occur in Low Earth Orbit where debris would gradually drop into successively lower orbits and eventually reenter the atmosphere, the debris would not be a permanent hazard to orbiting spacecraft. As BMDS testing becomes more realistic, there is a potential for an increased amount of debris reaching and remaining on orbit. A large portion of this debris would likely not remain on orbit for more than one revolution, and eventually all of the debris would be expected to de-orbit."

While these statements are perhaps true, they also serve to downplay the possible dangers of debris. The overall assumption in the PEIS that there is a low-level of risk is not supportable, due to the failure of MDA to undertake or provide adequate scientific review of the physics involved in debris creation and reentry, as well as of the multiple scenarios for missile defense intercepts. The following is an overview of the major inadequacies in the PEIS treatment of issues related to orbital debris.

The Dangers to Spacecraft from Orbital Debris

The PEIS fails to adequately address space as an environment that will be impacted by interceptor testing, deployment and usage.

It is a universally accepted fact that space is an environment that belongs to all humankind and thus must be protected. For example, harm to the space environment prohibited by both the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (known as the Outer Space Treaty) and the 1977 Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (know as the Environmental Modification Convention). It is also universally recognized that the space environment is in danger, becoming ever more polluted by orbiting junk left over from human activities in space. Space debris is the inevitable consequence of the global uses of space every single space launch will create some amount and form of debris, just as every kind of public transport on Earth creates some amount and form of pollution. Examples of space debris include: satellites that no longer function; spent and jettisoned rocket bodies; lens caps, bolts, and "exhaust products" from solid rocket motors and small particles such as paint flakes and bits of insulation from day-to-day erosion of orbital objects.

Already, there are ongoing efforts at the UN level to develop universally accepted practices to mitigate the creation of new space debris by space-faring powers; NASA is a key leader in this effort. "It's a classic environmental problem," according to Nicholas L. Johnson, chief scientist and program manager at the Orbital Debris Program Office at NASA's Johnson Space Center in Houston. "If you don't do anything about this for the next 10 or 20 years, then it's too late."

Space debris is dangerous because of its potential to collide with and damage satellites and/or spacecraft. Even tiny pieces of debris can cause destruction. Debris is so dangerous because objects in orbit move at extremely high speeds (about 10 kilometers per second in Low Earth Orbit) and so relative velocities and the energy generated at impact can be very large. The damage that would be caused by a collision in space depends on a number of factors, such as the size of the debris, the size and design of the spacecraft hit, and at what angle the two objects collide. Indeed, the PEIS itself admits that space debris created by missile defense activities (particularly multiple interceptor launches) could present a threat to the International Space Station and other objects in Low Earth Orbit (LEO).

The PEIS severely understates the potential threats to satellites and spacecraft from orbital debris caused by ground-based midcourse interceptor tests, deployment and usage, due to a failure by MDA to conduct adequate scientific review of the likely scenarios for interceptor impact and debris creation.

Ground-based interceptors will create debris in LEO if they impact their targets (Intercontinental Ballistic Missiles [ICBMs] fired at the United States) in the so-called

mid-course phase, when they are outside the Earth's atmosphere. In this phase, the ICBM will be either rising into LEO, at the peak of its trajectory, or starting to descend back through space into the atmosphere. The PEIS states, "The amount of orbital debris could increase from …Ground-based Midcourse Defense … . Such increases in orbital debris would be temporary, as studies indicate that objects in orbit between 200 and 399 kilometers (123 to 248 miles) reenter the atmosphere within a few months."

This statement, however, is somewhat misleading. Up to now, MDA has been configuring ground-based, mid-course intercept tests so as to avoid debris creation, conducting tests at low altitudes and slow speeds, with both interceptor and target on a downward trajectory, so debris created will rapidly reenter the atmosphere. In the last successful test in October 2002, the interceptor hit the target at an altitude in excess of 210 kilometers (140 miles) above the Earth, at a speed of about half of what would be required in a real-life scenario. Realistic testing and employment of a ground-based mid-course system would require intercepts at higher altitudes orbit of around 300+ kilometers and extremely high speeds, and would more likely take place with both the interceptor and the target flying in an upward trajectory -- facts of physics that would lead to the creation of more debris and likely result in debris being flung into a higher orbital plane than the altitude of the intercept itself. If the debris ends up orbiting at higher than 399 kilometers, it could remain in space for years. There is no evidence that the PEIS takes into account this latter possibility.

Even if the debris remains in space only for a "few months" it would still pose a potential threat to space assets in its orbital pathway, including perhaps, as the PEIS itself admits, the International Space Station (ISS). While, as the PEIS notes, the ISS can be (and has been in the past) moved to avoid potential collision with space debris, this is not a simple task and takes time. Indeed, the PEIS couches its language on threats to the ISS by saying only that it "may be possible" for the ISS to perform collision avoidance to get out the way of any "large debris" created. Further, many other satellites in LEO lack the ability to maneuver at all to avoid debris – a fact that the PEIS fails to mention.

Finally, the PEIS contradicts itself somewhat on the issue of debris risk by stating (on p. 4-132) that since the "debris created is expected to be small" and collision avoidance strategies could be used, there are "no significant impacts expected to the ISS." While it is debatable whether the debris would indeed be "small" – as the PEIS provides no actual modeling to predict the size of debris created by a ground-based midcourse intercept the fact is that small debris could actually be *more* dangerous to the ISS and other spacecraft in LEO. That is because current debris tracking systems cannot track debris smaller than 10 centimeters in diameter (about the size of a softball) adequately enough to allow planning of collision avoidance maneuvers. Debris between 10 cm and 1 cm in diameter (a bit larger than a marble) will penetrate and damage most spacecraft (as the PEIS admits on p. 4-131) and could possible destroy space assets depending on where debris strikes the spacecraft. It also should be noted that the orbital plane between 300 and 400 kilometers is already one of the bands of space most polluted with this size of debris.

The PEIS completely fails to support its claim that there would be no significant impact to spacecraft from the use of Space-Based Interceptors (SBIs) for either boost-phase intercept (as an ICBM is rising into the upper atmosphere) or midcourse intercept, due to the inability of the MDA to provide data required for necessary scientific review.

Given the inadequate articulation by MDA of the SBI concept and the lack of sufficient scientific coverage of space debris in this PEIS, it is impossible for the PEIS to make *any* claims about potential debris production from SBI tests, deployment or usage other than that the creation of debris is a certitude. The PEIS states (p. 4-118), "Using interceptors from a space-based platform would create orbital debris, from successfully intercepting a threat missile and causing it to break up or from the break up of any unsuccessful interceptor or space platform." It further notes (p. 4-118) that SBIs would travel through space after launch, and thus potentially endanger other satellites it their path. It does not, however, mention the fact that launching an SBI constellation into either LEO or GEO would also have debris impacts that might be significant.

The dangers of the debris created, however, can not be scientifically analyzed because the configuration of the SBIs themselves (i.e., their size, mass and speed) has yet to be revealed by MDA; neither has the architecture for their deployment (how many SBIs on orbit and at what altitude) or usage (how many SBIs would be fired at an incoming target) been publicly determined. As noted above, the potential for debris creation depends on a number of factors including the mass of the two objects, the speed of the impact, the altitude of the impact, and the angle of impact. With none of the specific parameters identified for a SBI system by MDA (including in this PEIS), these factors are impossible to model.

Second, even if "best guesses" about a SBI configuration are used based on previously proposed and internal MDA designs, the PEIS fails to take into account the issues mentioned above regarding altitude, size and persistence of debris created by midcourse intercepts, and likely dangers to spacecraft from it.

Third, and perhaps the most egregious inadequacy in the PEIS review of the SBI option, proposals for a SBI network postulate between 500 and several thousand interceptors in LEO each of which would be filled with a large amount of highly-volatile rocket fuel. Thus, the SBIs themselves would be in potential danger of colliding with space debris already on orbit. Such collisions could result in the explosion of the SBI. In fact, current orbital debris mitigation regulations in the United States and elsewhere, as a first-order priority, require space operators to vent any excess fuel from booster rockets used in launching satellites in order to avoid on-orbit explosions, which are proven to create vast amounts of wide-spread debris. The SBIs would also be constantly bombarded by smaller debris that could comprise their integrity. The PEIS completely ignores the possibility of SBIs being damaged by debris. And while the PEIS suggests the possibility that some SBIs also might be based in GEO, there is no effort to address the even more serious threats this architecture would pose to spacecraft. An SBI traveling toward the Earth from GEO would have many more opportunities to collide with other spacecraft as it passed

through subsequently lower orbital altitudes. Also as GEO is already highly crowded with satellites (mostly for commercial communications and broadcast), the threat of debris creation by a network of new, explosive SBIs based in that orbital band could be high. Neither of these potential threats is modeled in the PEIS.

Indeed, the PEIS itself states (p. 4-116) that "additional environmental analysis could be needed as the technologies intended to be used became more defined and robust." Even more worrisome, an article in the Sept. 13 edition of *Space News* ("Space-Based Interceptor Could Pose Debris Threat") reveals that MDA has not even held detailed discussions about the potential for damaging debris from space-based interceptors with NASA's Orbital Debris Program Office.

The Dangers to People, and Objects in the Air and on the Ground

The PEIS makes blanket statements about the lack of danger to aircraft, terrestrial objects and people from space debris created by midcourse intercept activities reentering the atmosphere that cannot be supported in the absence of further scientific review.

Space debris can also be a danger to people and things on the ground, as some space junk will inevitably de-orbit, drop through the atmosphere and land. Although such landfalls are rare, they do happen when very large space objects de-orbit. For example, large pieces of Skylab fell over Western Australia in July 1979; in April 2000 pieces of a Delta 2 second stage rocket fell over Cape Town, South Africa. In the latter case, more than 700 pounds of debris hit the ground, including a nearly intact fuel tank. The Delta rocket had been used to lift a satellite to Geosynchronous Orbit (some 36,000 kilometers) in 1996. A nearly identical event happened in January 1997, when a Delta 2 second stage hit the ground in Georgetown, Texas. One of the pieces of debris from that landfall was a 264 kilogram (580 pound) stainless-steel fuel tank identical to the once recovered in South Africa. That tank came about 50 yards away from a house, and also nearly missed a highway.

The PEIS states on a number of occasions that any debris reentering the atmosphere from a midcourse intercept (by either ground-based or space-based interceptors) event would likely be "small" and thus "burn up" before impacting the ground. Considering that a Delta 2 second stage is a good bit smaller than either an ICBM or the current design of the ground-based midcourse interceptor, that statement is debatable. Nor is it supported by the PEIS itself, which simply does not provide the scientific analysis needed to determine the size of debris created by a midcourse intercept or the possibility of it making landfall intact.

For example, in the case of a booster malfunction or a miss by an interceptor successfully launched from the ground, large pieces of debris likely would fall back to Earth. There is little evidence given in the PEIS to back its contrary assertion that debris would be small and limited in its "footprint." Even in the case of a successful intercept, there is no data

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provided by the PEIS about the likely size and altitude of debris, data that is required to predict whether or not pieces would make landfall intact.

As the size, mass and speed of any SBI remains undetermined by MDA, it is impossible for the MDA at this time claim that there would be little risk of landfall by debris. However, the possibility of an SBI missing its target and reentering the atmosphere is worrisome, and should be further reviewed using reentry modeling based on several SBI configuration options – modeling that has not been provided by the PEIS.

The PEIS (p. 4-70) also states that "even if an object does survive reentry, only one third of the Earth's surface is land area, and only a small portion of this land area is densely populated. The chance of hitting a populated land area upon reentry would be small." While this is a statement of fact, it does not take into account the trajectory of likely missile tests or intercepts over the Earth. Where reentry might happen is dependent on from where the target missile is launched as well as from where the interceptor is launched, and at what point in their individual trajectories impact is made. The PEIS fails to provide specific data about likely intercept scenarios required to model possible reentry points. For example, there is some question about MDA's ability to do intercept tests from Ft. Greely, the first location for the new ground-based midcourse interceptors, because of concerns about endangering people and the environment. Finally, the PEIS itself admits (p. 4-122) that "Objects reentering may skip off the Earth's atmosphere, similar to a stone skipping across a pond, causing them to impact much farther away than originally predicted."

The PEIS fails to adequately review the likelihood of risks to both aircraft and objects and people on the ground from debris created by space-based boost-phase intercept activities.

In the case of a SBI launch designed to hit an ICBM in its boost phase, it is currently (as with a midcourse design) impossible to predict with reliability the potential for debris to make landfall intact due to the lack of data about the configuration of SBIs. That said, however, a miss likely would result in major ground impact. That is because by any design, an SBI *must* be able to survive reentry of the atmosphere so as to hit the target ICBM before it *exits* the atmosphere. This issue is not addressed by the PEIS at all – and represents a fact that seems to run directly counter to the PEIS's assertion (p. 4-121) that, "Upon reentry, the majority of the space-based interceptor and its platform would burn due to the intense friction and heat created during reentry through the Earth's atmosphere."

Finally, the PEIS admits that any accident (such as a communications failure caused by a defect or jamming) that caused an SBI to reenter the Earth's atmosphere in an uncontrolled manner could create a danger to aircraft in flight. It states (p. 4-121), "Given the difficulty in predicting that path of uncontrolled reentering space-based interceptors and their associated platforms, little advanced warning could be given to clear airspace." It then goes on to assert that most objects break up upon reentry and the impacts to airspace would not likely be significant – an assertion for which no scientific backup is

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provided, especially given the fact that SBIs designed for boost-phase intercept would by their nature be required to reenter at least the upper atmosphere intact. Further, even smaller pieces of white-hot debris could severely damage an aircraft in flight.

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PERCHLORATE AND THE PROPOSED BALLISTIC MISSILE DEFENSE SYSTEM:
COMMENTS ON THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Lenny Siegel
October, 2004

Executive Summary

The Programmatic Environmental Impact Statement (PEIS) for the Ballistic Missile Defense System (BMDS) not only does an inadequate job of addressing the environmental impact of solid rocket propellant associated with this program, but it seems to ignore the purpose of the National Environmental Policy Act (NEPA). That is, rather than consider how to minimize negative environmental impacts in the design of a program, through "cradle to grave analysis," it uses the environmental document to justify decisions that have already been made.

Furthermore, the PEIS lacks a genuine "No Action Alternative," even though NEPA requires that such an alternative serve a baseline against which to compare the environmental impacts of the other alternatives. In particular, a No Action Alternative that posits little or no use of rocket propellant is essential if the program's proponents are to minimize releases of pollutants—particularly solid rocket propellant and its byproducts—into our nation's water supplies, air, or the upper atmosphere, either by selecting a program alternative or agreeing to binding mitigation measures.

Solid rocket propellant that contains ammonium perchlorate as an oxidizer is designed to generate large quantities of hydrogen chloride, which reacts with moisture in the atmosphere to create hydrochloric acid—that is, acid precipitation. The PEIS should consider how the missile defense program might develop and test alternate launch technologies that are not so environmentally destructive.

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When rockets are launched into the upper atmosphere, they directly deliver hydrogen chloride to the ozone layer, exposing human, other animals, and other biota to the harmful, persistent effects of ultraviolet-B radiation (UVB). Rocket launches are among the largest causes of ozone depletion, and the persistence of such substances from other sources is no excuse for additional pollution. The BMDS program should at the very least evaluate the mitigation of such seriously harmful environmental consequences through the development and deployment of alternative solid rocket propellants.

Perchlorate, primarily from the manufacturing, testing, aborted launches, maintenance, and decommissioning of solid rocket motors, is polluting the drinking water of more than twenty million people and may be endangering natural ecosystems from Cape Canaveral to the Marshall Islands. The PEIS understates the risks of exposure, and it fails to provide data on the quantities of solid rocket propellant likely to be produced, used, released, and disposed by the BMDS. The PEIS should consider the environmental consequences of various disposal strategies so the BMDS program can develop the technology or capacity to address its waste or consider the use of alternative launch technologies or strategies to minimize either the waste or the negative environmental impacts.

Conclusion

To ensure maximum environmental protection and reduce known, widespread human health risks from the use and disposal of solid rocket propellant, the Programmatic Environmental Impact Systems for the Ballistic Missile Defense System should compare the proposed alternatives against a genuine No Action Alternative. At a minimum it should::

1. **Provide more detailed estimates of perchlorate waste likely to be generated by system development, testing, deployment, maintenance, and decommissioning *and* acknowledge emerging regulatory standards for perchlorate exposure.**

2. **Consider in detail the management practices—launch protocols, treatment technologies, etc.—necessary to mitigate the significant environmental impacts, including increased depletion of the stratospheric ozone layer and the likely release of perchlorate into groundwater, surface water, and soil.**

3. **Evaluate alternative launch technologies not based upon ammonium perchlorate.**

Based upon such additional environment review, which I believe is mandated by any fair reading of the National Environmental Policy Act and its implementing regulations, Program Managers should use the information generated to help evaluate all alternatives and to mandate actions to minimize or mitigate the serious environmental consequences associated with such a large and continuing use of solid rocket propellant. Such steps are necessary to protect the American people, the ostensible purpose of the Ballistic Missile Defense System.

Introduction

I have been asked, by Physicians for Social Responsibility-Los Angeles, to review the draft Programmatic Environmental Impact Statement (PEIS) for the Ballistic Missile Defense System (BMDS), with a focus on the environmental impact of solid rocket propellant associated with this program. I find not only that the PEIS does an inadequate job of addressing these impacts, but like many other environmental reviews it seems to ignore the purpose of the National Environmental Policy Act (NEPA). That is, rather than consider how to minimize negative environmental impacts in the design of a program, through "cradle to grave analysis," it uses the environmental document to justify decisions that have already been made.

The PEIS lacks a genuine, "No Action Alternative," as required under NEPA. It rejects evaluation of the alternative, "Cancel Development of Ballistic Missile Defense Capabilities," because it "does not meet the purpose of or need for the proposed action ..." (page 2-68). This approach misunderstands how NEPA works. It is acceptable to evaluate and reject a No Action Alternative because it doesn't meet the purpose of a program, but the environmental impacts of that alternative must be considered as a baseline against which to compare the environmental impacts of the other alternatives.

In particular, a No Action Alternative that posits little or no use of rocket propellant is essential if the program's proponents are to minimize releases of pollutants into our nation's water supplies, air, or the upper atmosphere, either by selecting a program alternative or agreeing to binding mitigation measures.

The bulk of my analysis focuses on the manufacture, use, and disposal of solid rocket propellant containing ammonium perchlorate, because that is the propellant to be most widely used by the Ballistic Missile Defense program. However, liquid propellants, such as the hypergolic propellant containing hydrazine compounds and nitrogen tetroxide, are highly toxic, and the PEIS should consider how to minimize their environmental, health, and safety impacts as well.

At least by number, the 515 projected BMDS launches over the decade beginning this year dwarfs the 99 other projected government launches and the 77 estimated U.S. commercial launched anticipated over the same time period. The environmental review of such a large system, to be developed over a period of many years and potentially deployed for decades, provides an opportunity to reconsider the technologies that our country uses for launching rockets. The draft Programmatic Environmental Impact Statement ignores that opportunity.

Air Emissions

Solid rocket propellant that contains ammonium perchlorate as an oxidizer is designed to generate large quantities of hydrogen chloride. That is, hydrogen chloride is not generated as a product of incomplete combustion of when a system leaks. Rather, it is released as the normal combustion product of the reaction of aluminum and ammonium perchlorate. Then, hydrogen chloride reacts with moisture in the atmosphere to create hydrochloric acid—that is, acid precipitation. The PEIS briefly recognizes this:

> In biomes where rain is a frequent occurrence, launches with solid boosters have an increased likelihood of contributing to acid rain, thereby increasing the amount of HCl deposited in regional surface waters. In areas with low velocity of surface and groundwater movement and relatively shallow ground water table it is possible that deposition of acidic water may impact water resources. The potential for and extent of impact would need to be examined in site-specific environmental analysis. (page 4-60)

Waiting for site-specific analysis in the indefinite future condemns project sites to acid precipitation. There is no hint of how such an environmental impact might be mitigated. The proper analysis, at this stage, is to consider how the missile defense program might develop and test alternate launch technologies that are not so environmentally destructive. That is, the best solution is not likely be site-specific, so the PEIS itself should evaluate this impact.

The PEIS suggests that aluminum oxide, the other major combustion product of solid propellant, is non-toxic. (page 4-60) However, there is some evidence that aluminum in acid environments is toxic to fish.[1] The PEIS should review the literature and reconsider its conclusion based upon the weight of evidence.

Ozone Depletion

Furthermore, when rockets are launched into the upper atmosphere, they directly deliver hydrogen chloride to the ozone layer that protects the Earth against the harmful, persistent effects of ultraviolet-B radiation (UVB). The hydrogen chloride breaks down, releasing chloride ions that trigger catalytic reactions in which one chlorine atom can destroy over 100,000 ozone molecules. I call the delivery of chloride, in the form of rocket exhaust, to the upper atmosphere: "Free-basing the ozone layer."

Increased exposure to ultraviolet radiation causes universal damage to both human health and the natural environment. "... UVB causes nonmelanoma skin cancer and plays a major role in malignant melanoma development. In addition, UVB has been linked to cataracts.... Physiological and developmental processes of plants are affected by UVB radiation.... Scientists have demonstrated a direct reduction in phytoplankton production due to ozone depletion-related increases in UVB.... Solar UVB radiation has been found to cause damage to early developmental stages of fish, shrimp, crab, amphibians and other animals...."[2]

Once again, the PEIS acknowledges this environmental impact, but it plays it down: "The cumulative impact on stratospheric ozone depletion from launches would be far below and

[1] See, for example, Baker & Schofield, "Aluminum Toxicity to Fish in Acidic Waters," *Water, Air, and Soil Pollution*, 1987, cited in Heinz J. Mueller, Chief, Environmental Policy Section, Federal Activities Branch, U.S. EPA Region 4, "Environmental Assessment (EA) and Finding for No Significant Impact (FONSI) for the Proposed Titan IV Upgrade Program, Cape Canaveral Air Force Station (CCAFS) and Kennedy Space Center (KSC), FL," letter to Captain Anthony E. Fontana, III, Environmental Planning Division, Regional Civil Engineer, Eastern Region, Department of the Air Force, March 28, 1990.

[2] "The Effects of Ozone Depletion: The Connection Between Ozone Depletion and UVB Radiation," U.S. EPA, June 21, 2004. http://www.epa.gov/ozone/science/effects.html

indistinguishable from the effects caused by other natural and man-made causes." (page 4-114). I appreciate the data presented in Appendix I, but the conclusion reached by the authors is implausible.

The PEIS estimates that proposed BMDS launches from 2004 through 2014 would release approximately 1,350,000 kilograms (3,000,000 pounds) of chlorine, primarily in the form of hydrogen chloride, in the stratosphere. Annually, that would be 135,000 kilograms (300,000 pounds). In comparison, official U.S. EPA data estimates annual (2001) U.S. emissions of most destructive industrial ozone-depleting chemicals to total about 50,000,000 kilograms (110,000,000 pounds).[3] Compensating for the chlorine share of the industrial molecules, this means that the potential BMDS launch impact represents about .4% (.004) of the U.S. contribution to ozone depletion.

However, the industrial "emissions" are actually the residuals of production and use of chemical which have been phased out, under the Clean Air Act Amendments of 1990 and a series of international protocols. That is, these substances are already in the environment; nothing can be done to put them back in the bottle. Thus, each year stratospheric releases of rocket fuel exhaust become a larger fraction of the problem, as fewer industrial ozone-depleters are manufactured.

More important, the fractional contribution of rocket-launches to ozone depletion does not make it desirable. It is as large as all but the largest industrial releasers, before the phase-out took effect, and orders of magnitude larger than the releases from a home refrigerator or a car air conditioning system. Our environmental laws and policies do not excuse pollution simply because there are other, larger sources. That is, if I were a repairer of air conditioning systems, I could not—and should not—release chlorine-containing refrigerants into the atmosphere simply because a Titan or Delta launch vehicle emits much more chlorine.

For those unfamiliar with the working of our environmental laws, an analogy in criminal law might be instructive. We don't legalize shoplifting simply because some people conduct million-dollar armored car heists. We may tailor our response to the crime, but we don't say it's acceptable.

Similarly, with the release of ozone-depleting compounds to the atmosphere, we as a society might decide that we shouldn't abruptly end space launches that depend upon solid rocket propellant. Instead, we might set a goal for the deployment of alternatively fueled rockets. The PEIS considers no such goal, despite the urgent need to mitigate global ozone depletion.

The Defense Department, NASA, and others have conducted research on propellants designed to achieve the thrust of ammonium-perchlorate-based fuels without the environmental hazards, but these efforts are poorly funded, and there appears to be no urgency. The BMDS program should at the very least, in its PEIS, evaluate the mitigation of seriously harmful envi-

[3] "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2001," EPA 430-R-03-004, April, 2003. http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2003.html. Note that these numbers overstate the actual chlorine mass in these emissions, but they exclude less destructive substitute compounds.

ronmental consequences through the development and deployment of alternative solid rocket propellants.

Perchlorate Releases

In 1990, when I wrote my report, "No Free Launch,"[4] I focused on the exhaust emissions from solid rocket motors. For the past several years, however, another environmental catastrophe, the pollution of our nation's drinking water with perchlorate, has emerged as a comparable challenge. As many as 20 million people are today drinking water containing perchlorate from rocket fuel production, and hundreds of wells have been taken out of service to avoid further public exposure.

Even in low concentrations, perchlorate in drinking water and food poses a threat to public health, particularly for newborns and other young children. U.S. EPA explains:

> Perchlorate interferes with iodide uptake into the thyroid gland. Because iodide is an essential component of thyroid hormones, perchlorate disrupts how the thyroid functions. In adults, the thyroid helps to regulate metabolism. In children, the thyroid plays a major role in proper development in addition to metabolism. Impairment of thyroid function in expectant mothers may impact the fetus and newborn and result in effects including changes in behavior, delayed development and decreased learning capability. Changes in thyroid hormone levels may also result in thyroid gland tumors. EPA's draft analysis of perchlorate toxicity is that perchlorate's disruption of iodide uptake is the key event leading to changes in development or tumor formation.[5]

Rocket fuel wastes, from manufacturing, testing, training, maintenance, and decommissioning are a significant environmental hazard. This is a front page news story from California to Massachusetts, but it is barely mentioned in the PEIS.

Where it is mentioned, the authors understate the risks of exposure:

> It is now known that perchlorate's direct effects on the human body are limited to the thyroid gland, and only if ingested at very high levels for a prolonged period of time (typically years). Peer-reviewed studies suggest that perchlorate in drinking water below 200 parts per billion has no measurable effect on human health. These findings provide reason to believe that low levels of perchlorate (below 200 parts per billion) also have no measurable effect on pregnant women or fetuses. (Council on Water Quality, 2003) Currently there are no Federal drinking water standards for perchlorate. (4-56)[6]

[4] Lenny Siegel, "No Free Launch: The Toxic Impact of America's Space Programs," National Toxics Campaign Fund, August 1, 1990.

[5] "Perchlorate: Frequently Asked Questions," U.S. EPA, August 5, 2004. http://www.epa.gov/safewater/ccl/perchlorate.html

[6] Note: The cleverly named Council on Water Quality is an association of companies that have released perchlorate pollution into the environment, not a government agency or an unbiased observer.

The reason that there is no federal drinking water standard for perchlorate is that the Defense Department objected to EPA studies that suggested a standard of one part per billion (ppb). Meanwhile, regulatory agencies are using levels far below the 200 ppb asserted in the PEIS. On the way to establishing its own legal standard, California has adopted a Public Health Goal of 6 ppb.[7] In May, 2004, Massachusetts identified a reference dose for perchlorate that would correspond to a 1 ppb drinking water exposure limit. It too is close to promulgating a binding standard.[8] And while U.S. EPA will not promulgate a standard until after the National Academy of Sciences has completed its review, in the interim it has instructed its personnel to use an action level range of 4 to 18 ppb.[9]

The PEIS should offer estimates of the quantities of solid rocket fuel that will be manufactured for the BMDS, not just for testing, but for missiles that will be deployed and hopefully never be launched. From that figure, it can estimate the quantities of manufacturing waste—propellant flakes, chips, and wastewater—likely to be generated. The PEIS estimates that the BMDS program will launch 413 solid-propellant rockets, containing from under 500 kilograms (1,102 pounds) to 60,000 kilograms (132,277 pounds) of solid propellant each. About 70% of that propellant, by weight, will consist of ammonium perchlorate. But nowhere does it estimate what quantity of propellant will be contained in deployed missiles, or even how many missiles will be part of that system. Without that information there is no way to project the amount of propellant waste likely to be generated by the program.

Propellant Disposal

Disposal of missile propellant, for both refurbishing and decommissioning, is a significant financial and environmental cost. NEPA provides the opportunity to weigh those costs before system acquisition, so technological choices that minimize such costs can be considered. The Government Accountability Office (formerly the General Accounting Office) wrote:

> DOD regularly disposes of missiles and has an amount for disposal costs included in its annual budget request. Thus, because it is known at the time of acquisition that costs will be incurred for missile disposal, the probability criterion for recording a liability is met. The Congress has also recognized that disposal costs will be incurred and has emphasized the importance of accumulating and considering this information. For example, the National Defense Authorization Act for Fiscal Year 1995 requires the Secretary of Defense to determine, as early in the acquisition process as feasible, the life-cycle environmental costs for major defense acquisitions programs, including the materi-

[7] "Frequently Asked Questions (FAQs) About the Public Health Goal for Perchlorate," California Office of Environmental Health Hazard Assessment (OEHHA), March 11, 2004. http://www.oehha.ca.gov/public_info/facts/perchloratefacts.html

[8] "Perchlorate: Toxicological Profile And Health Assessment," Massachusetts Department of Environmental Protection, Office of Research And Standards, Final Draft, May, 2004. http://www.mass.gov/dep/ors/files/perchlor.pdf.

[9] Marianne Lamont Horinko, Assistant Administrator, "Memorandum: Status of EPA's Interim Assessment Guidance for Perchlorate," U.S. EPA, January 22, 2003. http://www.safedrinkingwater.com/community/2003/021203perchlorate_memo.pdf

> als to be used and methods of disposal. The life-cycle cost estimates are required before proceeding with the major acquisition.[10]

Solid rocket fuel, when deployed in missile systems, does not last indefinitely. It has a shelf life. Both strategic and tactical missiles must be de-fueled and re-fueled or replaced periodically. By 2009, the Army will need to demilitarize over 102,000 Tube-launched, Optically-tracked, Wire-Guided (TOW) tactical anti-tank missiles, and by 2015 over 306,000 Multiple Launch Rocket System (MLRS) rockets will also require demilitarization. These weapons contain over 45,000,000 pounds of ammonium perchlorate, as well as nearly 1,200,000 pounds of RDX and HMX, two other energetic contaminants.[11]

Other missiles become obsolete and require replacement. The Navy reportedly destroyed more than 350 Poseidon Sea-Launch Ballistic Missile second stage motors, each containing 17,000 pounds of solid propellant—about 6,000,000 pounds total—at Hill Air Force Base in Utah, and it is scheduled to be about a third of the way into the destruction of 800 larger Trident I rocket motors.[12]

GAO did not separate disposal requirements for refurbishing from disposal for decommissioning. In 1998, it tabulated over 574,000 missiles and 5,871 large solid rocket motors in the Defense Department inventory, most of which would require disposal.[13]

Yet the PEIS appears not to address the environmental aspects of missile maintenance and it gives only cursory mention to decommissioning:

> Decommissioning of missiles would first require the removal and proper disposal of liquid, solid, or hybrid (liquid and solid combination) propellants from the booster(s). Where possible, propellants would be recovered and reused. Aging motors that contain flaws would likely be decommissioned using open detonation.... Solid rocket propellant would be removed for reclamation or burning in a controlled environment, such as an incinerator. Where practicable, incineration or closed burning of rocket propellant would be performed. Most of the acid and particulates ejected during the burn would be collected in plume scrubber water. This water would be treated for acceptance by a publicly owned (or federally owned) water treatment works in accordance with a National Pollutant Discharge Elimination System (HPDES) permit. (p. 4-16)

Once again, the PEIS authors don't seem to be reading the newspapers. The disposal of solid rocket propellant through "hog-out" (washing out the propellant) or open burning/open detonation are some of the major sources of perchlorate contamination across the country. The

[10] "Financial Management: DOD's Liability for Missile Disposal Can Be Estimated," U.S. General Accounting Office, GAO/AIMD-98-50R, January 7, 1998, page 6.

[11] "Reusing and Disposing of Missile Munitions: Phase 2," U.S. Army Audit Agency, AA 02-145, February 25, 2002, pages 20-21.

[12] "Hill AFB to Destroy 800 Trident Motors, Project Expected to Last 17 Years," *Defense Cleanup*, June 19, 1998, page 4.

[13] "Financial Management," page. 8.

PEIS should note how much propellant will be used, how often it will be necessary to dispose, and what the environmental impacts of each disposal or treatment method are likely to be. Such information is necessary, not just to estimate the life-cycle costs of the program, but also to figure out in advance how to reduce financial costs and environmental impacts through system redesign or ongoing mitigation activities. That's the purpose of the NEPA process.

To its credit, the Defense Department has developed better technologies for treating and recycling solid rocket propellant. For example, the Army Aviation and Missile Command's Research, Development, and Engineering Center uses super-critical ammonia to process and reclaim the ammonium perchlorate from solid propellant. The Hawthorne Army Depot, Nevada, has installed a prototype biodegradation system processing wastewater containing ammonium perchlorate.[14]

However, the Defense Department does not currently have the capacity to dispose of its current missile demilitarization and disposal inventory by any method, let alone the dispose of solid-propellant in an environmentally sound manner.

- Thermal treatment can release dioxins into the atmosphere. Even at very low concentrations, these compounds are a global, persistent threat to public health.
- Open burning and detonation often releases perchlorate into soil and groundwater.
- Recycling means that significant quantities of perchlorate are likely to be used in construction and mining. However, evidence is emerging—from Westford, Massachusetts, for example—that such uses may be generating unacceptable levels of pollution, as well.[15]
- Treatment systems installed to date lack the capacity to treat all the solid or liquid wastes likely to be generated by BMDS manufacture, maintenance, and decommissioning.

Overall, the PEIS puts off consideration of the challenge of waste decommissioning, stating, "The environmental impacts associated with decommissioning of specific components would be more appropriately addressed in subsequent tiered environmental analysis..." (ES-20)

This is unacceptable. It can only lead to "end-of-pipe" solutions, even though the Defense Department's own environmental managers and specialists agree that environmental protection should be integrated into acquisition and even research and development. The 2001 Munitions Action Plan, for example, states:

> The current emphasis in acquisition of munitions of all types (air delivered, ground launched, and sea launched) is on improving accuracy, reliability and increasing distances between firing or launch points and targets (i.e., so-called standoff ranges). At the same time, the public and regulatory bodies are rais-

[14] "Joint Demilitarization Technology Program," Department of Defense, October, 2003. http://www.dtic.mil/biosys/org/demil_rept2003_final.pdf

[15] Carrie Simmons, "DEP: Westford 'Responsible' for Water Clean-Up," *Westford Eagle* (Massachusetts), September 30, 2004.

> ing concerns about explosives safety and the environmental effects of munitions. The DoD is also becoming more aware of the cleanup and environmental compliance costs associated with training, testing, demilitarization, and unexploded ordnance (UXO) responses.
>
> These developments have highlighted the need for DoD to address environmental and safety concerns, and costs, throughout the munitions life cycle. This cycle starts from the technology development and design phase to the end-state of use, UXO and munitions constituents cleanup on ranges, or demilitarization. Addressing these concerns early in the life cycle (during requirements definition and acquisition) has the potential to significantly reduce costs and avoid problems later.[16]

That is, if the review of the potential environmental impacts of a system such as the BMDS finds the potential for significant negative environmental impacts, then those designing the system, selecting programmatic alternatives, and managing its testing and deployment should continuously evaluate ways to minimize those impacts, from the beginning.

The PEIS should consider the environmental consequences of various disposal strategies so the BMDS program can develop the technology or capacity to address its waste or consider the use of alternative launch technologies or strategies to minimize either the waste or the negative environmental impacts.

Perchlorate Debris

The PEIS raises and then dismisses the potential environmental impacts from perchlorate debris from launch failure. Presumably the same issues arise if a missile is intercepted before burning all its fuel. It states:

> During flight termination or catastrophic missile failure of solid propellant boosters, pieces of unburned propellant could be dispersed over an ocean area of up to several hundred kilometers. Once in the water, ammonium perchlorate could slowly leach out and would be toxic to plants and animals. In freshwater at 20° C (68° F), it is likely to take over a year for the perchlorate contained in solid propellant to leach out into the water. (Lang et al, 2000, as referenced in U.S. Army Space and Missile Defense Command, 2003) Lower water temperatures and more saline waters would likely slow the leaching of perchlorate from the solid propellant into the water. Over this time, the perchlorate would be diluted in the water and would not reach significant concentrations. (U.S. Army Space and Missile Defense Command, 2003) (page 4-51)

The PEIS authors apparently not followed carefully the research of the Aerospace Corporations team, headed by V.I. Lang, mentioned in their text. This group, which has been

[16] *Munitions Action Plan: Maintaining Readiness through Environmental Stewardship and Enhancement of Explosives Safety in the Life Cycle Management of Munitions,* U.S. Department of Defense Operational and Environmental Executive Steering Committee for Munitions (OEESCM), November, 2001, page 16.

studying perchlorate releases from launch operations for the Air Force, concluded in their most recent report:

> As illustrated by our hypothetical case study, risks associated with the inadvertent release of perchlorate from accidental launch failures must be managed on a case by case basis because of the complexity of variables that can affect the release rate from propellants, and because each launch location has unique environmental characteristics. The same type of approach can be used to assess the risk of perchlorate releases from other operations where sold propellant may be dispersed.
>
> We recommend that a systematic approach to assessing potential impacts be used in the initial planning stages of a launch program, for example, in the AF Environmental Impact Analysis Process, which complies with the National Environmental Policy Act (NEPA). Regulatory agencies may require such analyses be performed prior to new launch programs. In this report, we have presented one type of step-wise approach to assessing perchlorate releases for a typical launch scenario.
>
> Initial studies performed by the University of Alaska on fish exposed to solid propellant in water samples, and in particular on fish exposed to perchlorate in water, indicate the potential for significant biological effects. Studies are also under way to determine the effect of released perchlorate on soil and plant species.[17]

The Army should follow the advice of the Air Force contractors and conduct site-specific analysis of the impact of perchlorate debris on any freshwater lake that might receive perchlorate debris as well as confined oceans waters, such as within the Marshall Islands, where repeated releases of perchlorate could damage sensitive ecosystems or essential food supplies. It should also work with NASA and the Air Force to ground-truth models on perchlorate releases by conducting actual water, soil, and sediment sampling for perchlorate at major launch facilities such as Cape Canaveral and Vandenberg Air Force Base.

Conclusion

To ensure maximum environmental protection and reduce known, widespread human health risks from the use and disposal of solid rocket propellant if the Ballistic Missile Defense System moves forward, the Programmatic Environmental Impact Systems for the Ballistic Missile Defense System should compare the proposed alternatives against a genuine No Action Alternative. At a minimum, to comply with the National Environmental Policy Act, it should::

[17] V.I. Lang et al, "Assessment of Perchlorate Releases in Launch Operations III," The Aerospace Corporation (No. TR-2003(1306)-2, prepared for the Air Force Space Command Space and Missile Systems Center (SMC-TR-04-11), September 18, 2003, page 27. This and other valuable Air Force/Aerospace Corporation studies on the likely environmental impacts of space launches may be found at http://ax.losangeles.af.mil/axf/studies/studypage.htm.

1. **Provide more detailed estimates of perchlorate waste likely to be generated by system development, testing, deployment, maintenance, and decommissioning *and* acknowledge emerging regulatory standards for perchlorate exposure.**

2. **Consider in detail the management practices—launch protocols, treatment technologies, etc.—necessary to mitigate the significant environmental impacts, including increased depletion of the stratospheric ozone layer and the likely release of perchlorate into groundwater, surface water, and soil.**

3. **Evaluate alternative launch technologies not based upon ammonium perchlorate.**

Based upon such additional environment review, which I believe is mandated by any fair reading of the National Environmental Policy Act and its implementing regulations, Program Managers should use the information generated to help evaluate all alternatives and to mandate actions to minimize or mitigate the serious environmental consequences associated with such a large and continuing use of solid rocket propellant. Such steps are necessary to protect the American people, the ostensible purpose of the Ballistic Missile Defense System.

Sacramento Area Peace Action
909 – 12th Street, Suite 118 Sacramento, CA 95814
(916) 448-7157 – www.sacpeace.org

Oct. 19, 2004

Missile Defense Agency, c/o ICF Consulting

Re: Ballistic Missile Defense System,
Draft Programmatic Environmental Impact System

I am here on behalf of Sacramento Area Peace Action and our 4,000 supporters, both to comment on the PEIS, and to register a complaint with the manner in which this hearing was scheduled. There has been no widespread publicity in California that we are aware of regarding this hearing today in Sacramento. Is this some sort of stealth strategy to limit public input on this crucial issue? We question if a Draft PEIS can be legitimate if there is not adequate notice of the document and the hearings on this matter.

What is most disturbing, however, is that the current administration is forging ahead with deployment of the first two interceptors for the BMDS, at Ft. Greely, Alaska, making a mockery of these hearings. And it is even more perplexing that the interceptors that were just installed have not yet been tested in this system! The tests have been continually postponed, and the Pentagon's chief weapons evaluator has said these interceptors may only be capable of hitting their targets about 20% of the time!

Why is our government spending billions of dollars and risking the beginning of a new nuclear arms race on a so-called missile shield with such an abysmal record?

The greatest danger we face is not from intercontinental ballistic missiles carrying nuclear warheads to our shores, but of re-igniting the nuclear arms race and motivating countries that fear us to attempt illegal acquisitions of nuclear weapons. They see that the technology for a missile defense system can also be used offensively against them. Their defense against our military superiority would be to either produce many nuclear ballistic missiles, to overwhelm our TWENTY-PERCENT system, or to use secret delivery systems – weapons smuggled into our country or delivered by short-range missiles launched just offshore.

Forging ahead with the Missile Defense System will also create terrible consequences: pollution from rocket launches, space debris, and accidents within the system or involving civilians. Other groups are scheduled to testify more comprehensively on these environmental hazards. But I am emphasizing here that all people on earth, not just Americans, face grave environmental threats from this drive to dominate the world by dominating space. The environmental pollution may kill us slowly, if we don't do it quickly with a nuclear war.

Thus the greatest environmental impact of the MDS will be to make our entire planet more dangerous to all forms of life, and we Americans are more vulnerable, not safer.

Most Americans consider a nuclear war unthinkable, but apparently our leaders and Congress do not. It is astounding to see the turnaround on proliferation and new nuclear weapons in this administration. Will threatening other nations encourage them to cooperate with the Non-Proliferation Treaty? Will the U.S. violations of the Treaty persuade other nations to embrace non-proliferation? We think not.

Similarly, the abrogation of the Anti-Ballistic Missile Treaty last year by this administration, in order to pursue this fantasy "missile shield" will not promote international cooperation on disarmament.

We can only conclude that this rush to further develop and deploy this ill-conceived "missile defense" shield is driven by ideology and politics, and fueled by the greed for profits from this costly boondoggle. That is what it is, a boondoggle. The leading scientists and Nobel Prize laureates have condemned this as unworkable and dangerous to global security, but this administration rushes headlong into a hasty deployment. The term coined to characterize this drive is "a rush to failure."

In conclusion, we at Sacramento Area Peace Action condemn the alternatives 1 and 2, with the extreme threat they pose to our nation and the world.

We would support the "No Action Alternative," if there had been a legitimate attempt at researching and weighing a true alternative of "no action." Such a proposal should have encompassed a suspension of research and development, no testing, and no initial deployment. It should have evaluated the cost-effectiveness of vigorous pursuit of international cooperation on nuclear disarmament. As it stands, the "No Action Alternative" does not meet the requirements of the National Environmental Policy Act.

For this reason, we consider this draft PEIS inadequate and insufficient for proceeding with the BMDS.

For the Board of Directors,

Winnie Detwiler

Winnie Detwiler

DC_PHW0006

Statement from MacGregor Eddy, advisory board member Global Network Against Weapons and Nuclear Power in Space Regarding the Programmatic Impact Statement (PEIS) for the Ballistic Missile Defense System (BMDS) Oct. 19, 2004 Sacramento California.

1. The 515 projected BMDS launches that are evaluated by the PEIS do not include the intended expansion of the BMDS program, and thus does not meet criteria of the National Environmental Policy Act (NEPA). This intended expansion was described on October 13 by General Henry "Trey" Obering the director of the Missile Defense Agency (MDA). Speaking at the Homeland Security Conference in Colorado Springs General Obering was asked about the new Theater High-Altitude Area Defense (THAAD) missiles scheduled to move into production in late 2005. In response General Obering stated they will ***"augment, not replace, the current generation of ground-based midcourse interceptors. In fact, there will be a continued spiraling up of capabilities in both missile networks, with more missiles and additional sites being added for the current missiles, and an expansion of THAAD beyond the initial scheduled 25 missiles"***

2. The PEIS does not evaluate the environmental impact of the ***no action*** alternative, and thus does not comply with the intent of the National Environmental Policy Act. Without this evaluation there is no way to compare the environmental impact of the program to the impact of the ***no action*** alternative, and thus violates both the letter and the spirit of NEPA.

3. The PEIS does not address the environmental impact of the response to BMDS by other countries. For example, China is planning to increase the number of missiles they have in direct response to the BMDS deployment. The development, testing, deployment and de-commissioning of these missiles in China will impact the global biome.

MacGregor Eddy

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October 19, 2004

Missile Defense Agency BMDS PEIS
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Dear Friends,

Women's International League for Peace and Freedom (WILPF) submits the following initial comment on the current draft Programmatic Environmental Impact Statement of the Missile Defense Agency.

WILPF is a ninety year old non-governmental organization that has worked tirelessly since its inception to put an end to war. WILPF has supported the development of international institutions and international law, and non-violent methods of conflict resolution that together can facilitate the co-existence of diverse nations and peoples on this planet.

We hope the comments of ourselves, and of others who oppose the militarization of space, will be considered seriously, and that both environmental concerns and concerns for the future of our human race will lead to suspension of this ill-advised and destabilizing missile defense program.

The MDA draft PEIS seeks to answer to detrimental environmental effects of three alternative development plans for Ballistic Missile Defense. We have found the answers disturbingly incomplete. We have also carefully considered all three alternatives presented and have concluded that it would be dangerous – and indeed disastrous -- for the future of our nation to proceed with any of them. It is impossible to comment on all the details in the 701 page document in this short space, but we expect to submit several supplementary comment papers on a few of the many issues of deep concern to us.

First, we are convinced that Alternative 2, which inclu[illegible] of space based interceptors, is completely unacceptable. We will subr[illegible]mments on both the issue of debris from experiments with space b[illegible]d on the development of laser weapons. We have other concerns re Alternative 2 that you will perhaps argue are beyond the scope of this PEIS, but that makes them no less important. One is the creation of orbiting debris in space which will remain there

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as a threat to future space exploration. The second of these is that space based laser interceptors will be a first step toward the more ambitious program of space weaponization already developed by the Pentagon and the Space Command, and presented in detail in the November, 2003 *U S. Air Force Transformation Flight Plan*. This is a direction in which no civilized nation should proceed!

We believe that Alternative 1, which does not include space based weapons, and Alternative 3, which is unclear on this point, are also unacceptable, even from a solely environmental viewpoint. We are concerned about the adverse effects in all of the resource areas discussed in the MDA PEIS including hazardous waste, legal restraints, decommissioning of the weapons systems, destruction of the ozone layer, global warming and rocket fuel pollution of our water and river systems. We are preparing supplemental comments on at least some of these concerns.

We also wonder why this expensive and almost certainly unachievable missile defense program has been developed in the first place. It does not answer to probable threats to our national security in the present or in the coming decade. It will do nothing to prevent terrorist attacks, and there is now no hostile country or group with the capability of firing inter-continental ballistic missiles at the United States. Missile defense seems rather to be preparation for future confrontation with the only two countries really capable of threatening our current military domination or challenging us with nuclear attack. Neither of them – China or Russia – is currently an enemy, but this aggressive program may well push them into organizing allies and forces against our own threat of global – and planetary -- domination.

With this in mind, we will submit an additional comment on what we consider to be the only feasible alternative approach to protection of our land and peoples from intercontinental ballistic missiles, from the ravages of nuclear, biological or chemical warfare – or, indeed, from either attacks by small bands of terrorists or from what we have come to call "conventional warfare" (e.g. our own recent "shock and awe" attack on Baghdad).

This Alternative 4 would include a return to the United Nations disarmament treaty process (which the current Administration is regrettably blocking), and assumption of a lead role in the continual development of enforceable and universally applied international law consistent with both the UN Charter and the Universal Declaration of Human Rights. The United States would re-enter that process as the most powerful and most militarized nation in the world and would have no substantial military rivals. This is a rare and critical moment in history and the choice is ours: the United States can lead the way toward a world freed from war with sustainable development and human rights for all – or this nation can drag the human race backward with it into a world ruled by war, military domination and the threat (or use) of weapons more powerful than any known before.

For us in the WILPF there is no question about which route is preferable. We are convinced that continuing with any of these three BMD programs will make the step-by-step process of nuclear disarmament impossible, make war on earth and in space inevitable, and seriously threaten human existence and the entire fragile web of life on our unique and precious planet. We urge all those in the Pentagon, the Missile Defense Agency and in the aerospace corporations to join us in choosing life over death and step-by-step peace building over further destruction of this planet and its fragile web of life

Sincerely,

Sandy Silver, President
United States Section

DC_PHW0009

Public Comment Form
Public Hearing for the BMDS PEIS
Sacramento, CA – October 19, 2004

Dear Participant:

We want to hear from you. If you have comments on the Draft Ballistic Missile Defense System (BMDS) Programmatic Environmental Impact Statement (PEIS), please use the reverse side of this form to bring them to our attention. If more space is needed, please feel free to attach additional pages. For additional information on the BMDS PEIS please visit our web site at

http://www.acq.osd.mil/mda/peis/html/home.html

If you would like to be notified when the Final PEIS is available, request a hardcopy of the Executive Summary or CD-ROM of the entire document, please check the appropriate lines on the form below and verify the accuracy of your address. When you have completed your comments, you may either leave this form with a person at the registration table, or mail, fax or e-mail this form by November 17, 2004 to

MDA BMDS PEIS
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Please Print

Name	Mr.__ Mrs.__ Ms.__ [illegible]
Organization	[illegible]
Mailing Address	[illegible]
Phone Number	
E-mail Address	
Notification of PEIS Availability	Yes __ No __ Hardcopy of Executive Summary __ CD-ROM of Final PEIS __

[illegible]

K-252

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Comment

1) THE PEIS APPEARS TO BE BIASED TOWARD MINIMIZING THE ENVIRONMENTAL IMPACT OF THE BOMBS. THERE IS AN INHERENT CONFLICT OF INTEREST IN THIS REPORT BEING WRITTEN BY THE DOE, WHICH HAS A STAKE IN THE BOMB'S PROJECT CONTINUING. AN INDEPENDENT ENVIRONMENTAL IMPACT REPORT SHOULD BE COMMISSIONED BY A NON-PARTISAN PANEL OF SCIENTISTS WITH EXPERTISE IN THE FIELD.

2) THE PEIS IGNORES THE OBVIOUS PROBABILITY THAT OTHER COUNTRIES WILL RESPOND TO THE BOMBS BY INCREASING THEIR OWN ICBM ARSENALS. THE ENVIRONMENTAL IMPACT OF A WORLDWIDE INCREASE IN ICBM'S SHOULD BE CONSIDERED, INCLUDING THE INCREASED POSSIBILITY OF ACCIDENTAL ~~[illegible]~~ [illegible] COUNTRY'S SCIENTISTS [illegible] IN [illegible].

3) THE PEIS DOES NOT CONSIDER THE POSSIBILITY THAT THE DEVELOPMENT & DEPLOYMENT OF SPACE BASED WEAPONS BY THE U.S. IS LIKELY TO STIMULATE SIMILAR PROGRAMS BY OTHER COUNTRIES AND INCREASE THE CHANCE OF ACCIDENTAL OR PURPOSEFUL DETONATIONS IN SPACE, INCLUDING SOME INTENDED FOR CIVILIAN PURPOSES.

4) THE "NO ACTION ALTERNATIVE" IS NOT TREATED SERIOUSLY, AS EVIDENCED BY THE ABSENCE OF THE WORLDWIDE ELIMINATION OF ICBM'S THROUGH DIPLOMATIC MEANS [illegible] INTERNATIONAL [illegible] EFFORTS, INCLUDING [illegible] [illegible] OF UN ARMS INSPECTIONS.

K.4.2 Responses to In Scope Comments

Exhibits K-2 (*Responses to Comments – BMDS and Components*), K-3 (*Responses to Comments – Environmental Impacts*), K-4 (*Responses to Comments – Miscellaneous*), and K-5 (*Responses to Comments – Proposed Action and Alternatives*) contain responses to various comments. Each exhibit outlines the issue topic, comment number, excerpt text, and MDA's response. Please note that some comment excerpts address the same issue and to reduce the redundancy in the table, the appropriate response is printed only once and the remaining comment responses for that issue refer to that response. Note that comment text was extracted verbatim from the submitted comments.

Exhibit K-2. Responses to Comments – BMDS and Components

Issue Topic	Comment Number	Excerpt Text	Response
BMDS and Components	E0162-8	6) The PEIS contains a short discussion of future laser weapon systems (page F-7) and the Tactical High Energy Laser (page F-9). It notes that testing of a laser demonstrator began in 2000. The PEIS should review these tests and testing plans for other high-power laser weapons and other directed-energy weapons. An article in the 18 Dec. 2002 Jane's Defence Weekly indicated that a megawatt-class free-electron laser could be tested at PMRF in two to three years.	As indicated Section F of the PEIS discusses those advanced systems that MDA is monitoring for maturation of technology and potential application and integration into the BMDS. The PEIS describes the proposed BMDS components and testing activities in sufficient detail to facilitate a programmatic analysis of the potential impacts. The PEIS is intended to serve as a tiering document for future site- and component-specific analyses. If future plans identify specific locations that are required to support laser activation tests, they would be considered in subsequent tiered NEPA analyses.
BMDS	E0030-1	8) Unless the offensive missiles are sensed on launch and destroyed during boost, the dirty bomb effects will rain on the targets anyway; and the proposed system is not designed to intercept during boost.	The BMDS is envisioned to be capable of defending against all classes of threat ballistic missiles in all phases of flight (i.e., boost, midcourse, and terminal). Currently configured or planned BMDS elements that would defend in the boost phase include the Airborne Laser (ABL) and Kinetic Energy Interceptor (KEI).
BMDS	E0162-7	5) The PEIS has no discussion of the unresolved safety issues involving Strategic Target System and THAAD launches at PMRF which I noted in my scoping comments (second comment on page B-15). No detailed hazard	There are inherent risks with any missile testing activity; however, protection of life and property, on and off range, is the prime concern of Range/Mission Safety personnel. The Range Commanders' Council (RCC)

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		areas have been shown for Strategic Target System launches at azimuths other than 280 degrees. Similarly, no diagrams showing the THAAD hazard area were given in the 2002 THAAD EA and no detailed analysis was cited to justify the reduction in the hazard area radius from 20,000 feet in the 1998 PMRF EIS to 10,000 feet in the THAAD EA. There can be no meaningful public evaluation of the risks of such launches without this information.	Common Risk Critieria for National Test Ranges (RCC 321-02) sets the requirements for minimally acceptable risk criteria for occupational and non-occuptational personnel, test facilities and nonmilitary assets during range testing operations. Under RCC 321-02, individuals of the general public shall not be exposed to a probability of fatality greater than 1 in 10 million for any single mission and 1 in 1 million an an annual basis. Range safety personnel also apply launch window criteria that consider various weather and climatic conditions as appropriate. However, this PEIS is intended to provide a programmatic analysis of the potential impacts associated with the development, testing, deployment, and decommissioning of the BMDS. The PEIS is not a site or component-specific environmental analysis, and therefore does not provide specific information about particular components or their operation at various facilities.
BMDS	E0162-10	8) In 2002 the Defense Dept. announced that it would classify details about missile defense tests that had previously been public information. How can the public and independent technical analysts assess the impacts of tests and judge the effectiveness of BMDS components if this information is unavailable? Similarly, how can one estimate the impacts of entirely secret programs?	The PEIS provides sufficient technical information on the BMDS to enable both the technical analyst and a member of the general public to conduct a programmatic analysis of the environmental impacts potentially associated with the development, testing, deployment, and decommissioning of the BMDS. For specific technical information please see Volume 1 and Volume 2 - Appendices D, E, and F of the PEIS. The BMDS components, functions and activities are adequately explained and evaluated in the PEIS, but specific test results measuring system effectiveness are not necessary

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			for assessing the potential environmental impacts of implementing the BMDS.
BMDS	E0162-15	13) The example test scenario on page 2-13 involves use of the Cobra Dane radar. However, the August 2003 GAO report GAO-03-600 noted that there were no plans to test this radar using BMDS targets. Are such tests now planned in the next ten years?	The reference in Section 2 to the use of the COBRA DANE radar is an example test scenario and is not meant to refer to a specific test scenario. However, since the publication of the Draft PEIS, the COBRA DANE radar did participate in tracking BMDS target missiles in September 2005. The PEIS provides a programmatic review of the proposed BMDS and is not intended to address the potential environmental impacts of specific tests. Specific test scenarios can only be analyzed in subsequent environmental documentation, as appropriate. It also should be noted that the GAO report was published in 2003 and therefore may not contain the most up-to-date information regarding current plams for using or including BMDS assets in specific tests.
BMDS	E0162-16	14) The details of integrated flight test events are characterized as "only conceptual at this time" on page 2-50. Some test scenarios examined in the 2003 GMD ETR EIS had jet routes between Hawaii and the West Coast crossing the target and interceptor debris areas. What details about these tests will be made available for public evaluation?	The test scenarios examined in the 2003 Ground-Based Midcourse Defense Extended Test Range (GMD ETR) EIS, as well as those discussed on page 2-50, are representative of the range of potential test scenarios envisioned by MDA test planners and show that coordination with the Federal Aviation Administration (FAA) and other agencies would be required because air traffic potentially could be affected by target and interceptor debris. This PEIS process affords the public the opportunity to provide input on the types of environmental impacts potentially associated with testing various components and integrated system testing. This PEIS is not a site or component-specific environmental

Exhibit K-2. Responses to Comments – BMDS and Components

Issue Topic	Comment Number	Excerpt Text	Response
			analysis, and therefore does not provide specific information about particular components or their operation at various facilities. As specific test requirements become known, site/test-specific NEPA analyses will be prepared, appropriately tiered from this PEIS. If range or air traffic safety concerns arise regarding specific tests, MDA would identify airspace activities that need to be coordinated with the FAA to issue Notices to Airmen (NOTAMs) prior to those specific tests.
BMDS	E0162-17	Section D.2 has a brief discussion of land-based and sea-based Kinetic Energy Interceptors (KEI) for use as possible components of a boost-phase defense. It should be noted that a study of possible boost-phase defenses -- including surface-based and space- based KEI -- found that they would have limited capability against liquid-fueled ICBMs and were unlikely to be practical against solid-fueled ICBMs. This study was done by an American Physical Society study group and was released in July 2003. It is available at www.aps.org/public_affairs/popa/reports/nmdO3.cfm	These comments have been noted for the record. The PEIS does not address DoD threat assessment policy-making or the technological feasibility of missile defense system design.
BMDS	E0319-4	6. Include detailed information on High-Powered Microwaves ('Directed Energy') will be used as part of the BMDS and the environmental hazards associated with their transmission into the atmosphere and ionosphere (include human Electromagnetic Radiation (EMR) hazards)	The commenter's concerns are unfounded. No electromagnetic (EM) phased array or microwave radars are currently located at Kodiak Launch Complex (KLC). Additionally, no radars or radios located at KLC approach a power output in the range of 1.9 megawatts (MW). The existing radars include very high and ultra high frequency (UHF) radars with power outages ranging between 0.5 MW to 1 MW.
BMDS	E0319-13	The Draft PEIS did not give enough detail on the variations of BMDS 'Directed Energy' weapon systems in	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
		Appendix F-'Advanced Systems' (e.g. high-powered microwaves), or proposed ground-based test locations. All proposed plans should be included in the PEIS for directed energy weapons. A high-power 'electromagnetic' phased array radar network is located on Kodiak Island, Alaska, but the MDA has refused to acknowledge its existence or purpose in all previous Kodiak Launch Complex Environmental Assessments since 1999 (when the microwave system started operating). The microwave's 1.9 Mega Watts (MW) of power has the potential to be used as a BMDS weapon by turning on its high power and directing it at a target or missile, thereby disabling the target's electronics and/or 'heating' up the target and causing it to explode in flight. The U.S. Air Force has received funding for several years for its 'Directed Energy' or 'Electromagnetic Warfare' program (which includes high-powered microwave systems). It is time for the MDA to 'declassify' the program and acknowledge the Kodiak microwave and explain how it will be used in BMDS testing and the human health hazards to Kodiak Island residents from the electromagnetic radiation (EMR) when the microwave is operating.	
BMDS	E0319-17	BMDS Draft PEIS Volume 2, Page D-27-Deployment; MDA proposed plans for 2004-2005 include as many as 16 interceptors (GBI) at Fort Greeley, Alaska and 4 interceptors at Vandenberg AFB, California; However, no mention is made regarding the number of interceptors at the KLC. Why not? Are missile silos being proposed for	The GMD ETR EIS did analyze the environmental impacts of launching interceptors from KLC. As the commenter correctly states, the MDA announced in a Record of Decision (ROD) that there were currently no plans to launch interceptors from KLC. This is still the case. The information presented in Appendix D has

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		Kodiak Island? If so, how many? If not, state the launch method.	been corrected in the Final PEIS to reflect that there are currently no plans to launch interceptors from the KLC.
BMDS	E0319-26	Another area of concern that is mentioned in the Draft PEIS, is the MDA's current testing of Israel's 'Arrow Weapon System' in the United States. The October 24, 2003 'Arrow System Improvement Program (ASIP) Environmental Assessment' (EA), discusses the MDA testing of the system over a 4 year period, with "targets being launched from either the Mobile Launch Platform in the Point Mugu Sea Range or Vandenberg AFB". According to the Arrow System EA, the Arrow interceptor would intercept a "liquid-fueled target system (LFTS) that uses a main liquid fuel, an oxidizer, and an initiator fuel for vehicle motor ignition and propulsion". The EA further states: "the Arrow interceptor missile is a two-stage vehicle launched from a six-pack mobile launcher. The missile contains approximately 1,670 kilograms (3,600 pounds) of solid rocket propellant in the booster. The interceptor with the propellant has a hazard classification of 1.3 and consists of hydroxyl terminated polybutadiene (HTPB), ammonium perchlorate, and aluminum powder. The interceptor also contains an optical (infrared) seeker and a radar sensor. The payload includes a focused blast-fragmentation warhead, with a hazard classification of 1.1D. Combined, the Arrow interceptor missile with its payload has a hazard classification of 1.1." Considering the Arrow interceptor missile has a Hazard class of 1.3 ('mass fire') and the payload's warhead a Hazard class of 1.1 ('mass explosion'), the PEIS should include information on all potential ground-based hazards	The PEIS describes the proposed BMDS in sufficient detail to facilitate a programmatic analysis of the potential impacts of conducting integrated system testing. The PEIS is intended to serve as a tiering document for future site- and component-specific analyses. The Arrow System Improvement Program (ASIP) Environmental Assessment (EA) referenced by the commenter addressed the potential environmental impacts of the testing of the Arrow Weapons System Improvement Program. As future plans for testing the Arrow Weapons System are identified appropriate environmental analyses will be conducted. In addition the ASIP EA has been incorporated by reference in the Final PEIS.

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		(and locations) and space-based hazards from the Arrow 'interceptor' and exploding 'warhead' that will release chemicals and add to further air and land contamination if there is a launch accident (or even if there is not an accident). Also, list the name of the warhead in the PEIS. It should have been listed in the Draft. In fiscal year 2004, the ASIP "Caravan 2 would consist of two flight tests of the enhanced Arrow Weapon System at a U.S. test range (to be determined) against a threat-representative target at approximately full range" (BMDS Draft PEIS, Volume 2, page D-46). The October 24, 2003 'Arrow Weapon System Improvement Program EA'-Alternatives to the Proposed Action- Alternatives Not Carried Forward, states: "A number of candidate test ranges were examined, in addition to the Point Mugu Sea Range. All of the candidate test ranges were analyzed for various operational and technical considerations including safety, range availability, instrumentation, operational cost, and logistical support. At the conclusion of the evaluation, only the Point Mugu Sea Range met the ASIP test program requirements". This is contradictory with the statement in the Draft PEIS (Volume 2, page D-46), which states a U.S. test range '"would be determined" for the Caravan 2 flight tests. Since the release of the ASIP EA in 2003, the BMDS PEIS should include all updated plans to launch the Arrow	

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		interceptor missile from other test launch sites/locations (e.g. Reagan Test Site, Kwajalein Atoll, Aleutian Chain, Gulf of Alaska, Poker Flats Rocket Range, Fort Greeley, or the Kodiak Launch Complex). The fact that Israel does not have land available for 'interceptor' missile testing, does not justify the MDA's decision to bring and test another country's 'experimental' war weapons into the U.S, which will contribute to the pollution of U.S. oceans, drinking waters, air and land. Nor should the MDA be helping Israel by testing weapons that will then be shipped back to Israel to be used against its enemies in its 'religious' war, in order to further the 'Israeli Terminal Missile Defense' program. The United States should be doing what it can to negotiate peace rather than promoting war via another country. The wording is not much different in the excuse the MDA gives for testing the Arrow interceptor in U.S. territory- "Commitments to Israel would not be fulfilled, and the United States would not realize any benefits to its own Terminal Missile Defense test program from participation in the ASIP" (Arrow System Improvement Program EA, October 24, 2004).	
BMDS	E0395-9	Also, the relationship between NFIRE and space-based missile defenses, alluded to in the PEIS, should be clarified.	A description of the proposed Near-Field Infrared Experiment (NFIRE) risk reduction activities as they relate to the BMDS is provided in Appendix D, Section D.2 of the PEIS. The NFIRE experiment will allow the MDA to gather additional data about operations from space-based platforms including platforms that could be used to host space-based weapons.

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BMDS	E0395-14	Except for the largely historical discussion in Section D.3, the PEIS does not adequately describe AEGIS BMD operations, the large number of missiles involved, nor the locations where testing or training with those ships and missiles will be conducted, nor the environmental impacts of operational deployment with those ships or missiles.	Aegis Ballistic Missile Defense (BMD) operations are addressed in the PEIS to the same extent as other ballistic missile defense programs. As detailed in the PEIS the individual program elements while developed individually historically are now undergoing integration testing to provide a layered BMDS capable of destroying all ranges of threat missiles in all flight phases. Specific test locations and activities are not analyzed in the PEIS; however, MDA routinely considers all test activities, including those involving Aegis BMD as player or watcher, to determine and prepare the requisite level of NEPA analysis. MDA will continue to consider the environmental impacts of its testing programs tiering from the PEIS, as appropriate.
BMDS	E0395-15	The environmental impacts of the development, testing, training, and deployment of the proposed new, high-speed, Kinetic Energy Interceptors are not adequately addressed. In particular, the number and size of these large interceptors is not described nor are the types of propellants and chemicals involved.	The KEI program is described in Appendix D, Section D.2 of the PEIS. This program was in the earliest planning stages by the MDA and the U.S. Air Force (USAF) at the time of release of the Draft PEIS. The USAF Space and Missile Systems Center addressed the NFIRE in the Orbital-Sub-Orbital Draft EA. Preparation of environmental analysis for the KEI is in the planning stages. This PEIS includes sufficient information to facilitate a programmatic analysis of the potential impacts of a KEI interceptor. This affords the public the opportunity to comment on the types of environmental impacts potentially associated with typical testing early in the development and testing process.
BMDS	E0427-9 and E0439-9	Both the PAC-3 and Aegis Cruisers are included as components of the proposed BMDS Since the PAC-3 is a relatively short range system and is not designed for intercepting ICBMs, how many PAC-3 batteries will have	Issues surrounding the effectiveness of specific BMDS components, numbers of units required to provide a tactical advantage, and tactical operation are not germane to the analysis of the potential environmental impacts of

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		to be deployed to offer full protection for the American and allied cities and military bases. Are these within range of any civilian aircraft? How will they discriminate attacking aircraft from commercial and civilian aircraft? The MDA needs to consider how many civilians and US/allied military personnel will be accidentally killed by the BMDS.	implementing the BMDS. The PEIS is intended to provide a programmatic analysis of the environmental impacts potentially associated with the development, testing, deployment, and decommissioning of the BMDS, and it provides the framework for assessing the envelope of MDA activities considering an integrated BMDS and on a cumulative basis. The PEIS does not evaluate the deployment of the PATRIOT Advanced Capability-3 (PAC-3) at specific sites in the U.S. If the PAC-3 system is deployed in the future additional analysis will be conducted, as appropriate.
BMDS	E0427-10 and E0439-10	11) The PEIS provides conflicting information on the effects of the ABL on health and safety. The PEIS does not quantitatively assess the risk of the Airborne Weapons Laser (in a Boeing 747) blinding pilots and/or other civilians, stating mainly that humans and others would be exposed to the laser beam, mainly as reflected light for less than 0.01 seconds. However the PEIS provides no data on the wattage or power of these lasers in the PEIS making it impossible to assess the dangers of such laser exposure, especially to the eyes.	We disagree with the commenter's assertion that the PEIS provides conflicting information on the effects of the ABL on health and safety. The PEIS states that the ABL lasers are ANSI Class 4 lasers, and that the high energy laser is a megawatt class laser, the beacon illuminator laser and track illuminator laser are kilowatt (kW) range lasers, and the active ranging system operates in the range of 100 watts. The PEIS also addresses the potential impact of lasers on human health and the environment and acknowledges, for example, that severe damage to the fovea could occur if focused light energy were to strike the retina, but that the damage would be less severe if the eye were pointed somewhere off to the side rather than directly at the source. But as explained in the PEIS, the ABL would be tested in airspace areas that are appropriate for this type of activity and MDA test planners would follow all applicable guidelines and regulations, such as establishing restricted areas, displaying warning signs, designating restricted areas, clearing airspace during

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			tests, and removing reflective surfaces to ensure that the laser does not adversely harm health and safety. Thus, the PEIS describes the proposed BMDS and ABL in sufficient detail to facilitate a programmatic analysis of the potential impacts of the ABL on health and safety.
BMDS	E0427-13 and E0439-13	12) The MDA PEIS needs to consider whether boost phase BMDS interceptors could be launched erroneously, causing another country to believe it was under attack, and thereby triggering a nuclear war. The American Physical Society examined the issue of boost phase intercept, and determined that the interceptor has to be very close to the ICBM. be launched within about 15-60 seconds from the time the ICBM was launched, and have much greater accelerations than the ICBM http://www.physicstoday.org/vol-57/iss-l/p30.html (Kleppner et al. 2004). The problem of boost Phase intercept is greater for solid rockets with high accelerations than for slower accelerating liquid rockets. The further problem is that ship based interceptors are not big enough and do not have sufficient accelerations to make a boost phase intercept even from a small country like North Korea. If it did intercept, it is likely the warhead would not be destroyed by a kinetic hit-to-kill interceptor and would continue on to near its intended destination. Finally, they point out that a boost phase launch intercept of a ICBM from North Korea would likely occur over northern China, further risking causing China to think it was under attack by the US which could cause a nuclear war (Kleppner et al. 2004). The BMDS needs to consider the realities of the limitations of any	The BMDS is envisioned to be capable of defending against all classes of threat ballistic missiles in all phases of flight (i.e., boost, midcourse, and terminal). Currently configured or planned BMDS elements that would defend in the boost phase include the ABL and KEI. The ABL would be deployed to and operate in areas where boost-phase intercepts could be attempted. The PEIS describes the proposed BMDS including weapons that would defend in the boost phase, in sufficient detail to facilitate a programmatic analysis of the potential impacts. However, this PEIS does not address DoD threat assessment policy-making or the technological feasibility of missile defense design.

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		BMDS relative to a real no-action alternative of working toward disarmament through arms control treaties.	
BMDS	E0427-14 and E0439-14	13) Space debris from high altitude, mid-course missile intercepts or destruction of satellites. The PEIS does mention that even tiny particles of space debris traveling at extremely high speeds in orbit can destroy space suits, rockets and satellites. While the PEIS correctly points out that debris from low orbital intercepts will decelerate once it hits the atmosphere, and thereby de-orbit. However the PEIS fails to consider the space debris from high altitude intercepts which risk producing space debris that could make space unusable for many years. While the PEIS considers testing the BMDS on "targets of opportunity", no mention is made of space debris resulting if other nations target US BMDS satellites or components in high orbit as "targets of opportunity". This must be considered since the resulting space debris could destroy objects in space, making space unusable as well as violating the 1967 space treaty.	The PEIS considers the environmental impacts including the impacts from orbital debris from increasingly realistic testing scenarios including higher altitude and higher speed intercepts. Technical Appendix L has been added to the PEIS to provide additional rationale for the determination of impacts described in the PEIS for orbital debris. For the purposes of the BMDS PEIS "targets of opportunity" are launches or tests conducted for other programs that can be used as part of a passive test of the BMDS. For example, the launch of a National Aeronautics and Space Administration (NASA) launch vehicle may be observed by BMDS sensors to test equipment. In this example scenario, the NASA launch vehicle would be a "target of opportunity." Therefore, targets of opportunity do not create space debris as part of BMDS testing activities.
BMDS	PHO0011-3	Furthermore, while the PEIS considers testing the BMDS on targets of opportunity, no mention is of the space debris resulting from U.S. targets of opportunity or other nations' targets of opportunity.	See previous response.
BMDS	E0427-15 and E0439-15	14) The environmental consequences of many rocket launches needed to deploy and maintain space- based interceptors has not been adequately considered, nor has the environmental consequences of their fuel. Will space-based satellites/interceptors use nuclear power sources? Will any BMDS interceptors ever use nuclear warheads? While nuclear tipped-interceptors are not mentioned in the PEIS, per se. In Section 2.2.1.1 the PEIS does mention	As stated in the BMDS PEIS, the launch vehicles used to insert space-based platforms into the proper orbit would likely be existing launch vehicles; therefore, the impacts of these launches would be as described for Support Assets. The PEIS states that interceptors may use non-nuclear lethality enhancers to increase the probability of a

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		the possibly of destroying a missile by using interceptors with directed blast fragmentation kill vehicles. However the PEIS, fails to reveal the nature of the blast fragmentation device, which is needed for evaluation of its environmental effects. Instead the MDA PEIS states that "the interceptors will be discussed and analyzed for environmental impacts at the booster and kill vehicle level. This will allow the MDA the flexibility to configure new interceptors based on boosters and kill vehicles analyzed in this document to address new or emerging threats." This does not allow a satisfactory evaluation of the hazards of the BMDS components. What blast fragmentation devices will be used? The PEIS needs to include the details of chemical and toxicant use and exposure.	successful intercept. The PEIS also states that because the BMDS does not include nuclear weapons, the requirements of DoD 4160.21-M-1, Appendix 4, Category XVI, Nuclear Weapons and Test Equipment do not apply. The PEIS describes the proposed BMDS including interceptors, in sufficient detail to facilitate a programmatic analysis of the potential impacts of implementing the BMDS.
BMDS	E0427-16 and E0439-16	15) Radioactive and/or biological weapons fallout from intercepted missiles has not been considered in the PEIS. If a kinetic hit to kill interceptor knocks out an ICBM in the mid phase or terminal phase, the nuclear warhead or its fragments are going to produce a tremendous amount of radioactive contamination where ever they land. Such radioactive fallout will clearly have major, highly deleterious effects on adults, children, and especially on developing embryos, and fetuses. While such an interception is very likely to be highly preferable to damage resulting from an air or ground burst over a city, the resulting radioactive contamination needs to be considered. The effects of war are normally excluded from analysis by the National Environmental Policy Act (NEPA). However, the proposed BMDS action is very likely to provoke a worldwide WMD arms race, and force	There would be no radioactive or biological material from missile intercepts during system integration testing of the proposed BMDS. Such material would not be used in any targets used for intercept and would only be expected in enemy missiles which would be launched to attack the U.S. Any intercepts resulting from such an act of war upon the U.S. would not need to be considered in this PEIS, because as the commenter correctly points out the effects of war are normally excluded from analysis under NEPA.

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		other nations to prepare to launch a massive retaliation against the US should war ensue. Thus, these effects need to be considered relative to a real no action alternative. Since the proposed BMDS is very likely to cause a massive arms race, the environmental consequences of a resulting War involving nuclear or other WMD should not be ignored. The PEIS needs to consider the environmental effects of fallout from intercepted WMD as well as the effects of WMD the BMDS fails to intercept. Thus PEIS needs to consider these hazardous waste and materials issues. Appropriate references include "The Effects of Nuclear Weapons, Compiled and Edited by Samuel Glasstone and Philip Dolan, third Ed. DOD, DOE. 1977.	
BMDS	E0427-18 and E0439-18	17) Also note that the technology and environmental effects of "advanced systems" remain to be defined. How can the environment effects of an undefined "advanced system" be evaluated in this PEIS? A full environmental analysis is needed for each component of the PEIS to be added. If any component of the BMDS will ever use nuclear warheads in any interceptors the MDA needs to thoroughly consider the environmental effects, as discussed above.	Appendix F of the BMDS PEIS provides a brief overview of proposed Advanced Systems concepts. Because these ideas and concepts are still emerging, the BMDS PEIS provides a top level review of these programs, as the technology for these systems becomes more advanced, additional tiered site- and component-specific analysis will be developed as required. In addition, see response to comment DC_E0439 (DC_E0427)-15.
BMDS	E0427-19 and E0439-19	18) Will any MDA interceptors or Lasers use anti-matter weapons? A US Air Force anti-mater weapons research programs has recently been described in the SF Chronicle http://sfgate.com/cgi-in/article.cgi?file=/c/a/2004/10/04/MNGM393GPKl.DTL. IF the BMDS will use antimatter weapons or energy sources, the environmental effects including the health and safety risks, and chemical exposure risks need to be described in detail.	The BMDS envisioned by the MDA would include the use of weapons as described in the BMDS PEIS. The BMDS would not include the use of "anti-matter" weapons.

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BMDS	E0427-21 and E0439-21	The following points are points that need to be considered in the no action alternative. 20) The PEIS needs to consider whether the BMDS will result in Proliferation of Weapons of Mass Destruction (WMD) and an arms race in space. The response of other nations to the BMDS has not been considered. Specifically, the BMDS is coupled to other offensive weapons programs and will force other nations to proliferate and/or smuggle WMD so that they can re-establish deterrence. Relatively inexpensive countermeasures to BMD will likely thwart the goals of BMD. Such proliferation coupled with increased international tension will decrease rather than increase our security and lock us in to an expensive and destabilizing amis race and will have devastating long-term environmental consequences.	The Department of Energy (DOE) review was critical because it involved the use of nuclear power, which is not an issue associated with the proposed BMDS. The nature of the proposed system is one that is comprised of existing and new/proposed systems/technologies that are becoming mature and providing new capabilities to destroy a threat missile before it could carry out its mission. It is not reasonable to assume that all activities would stop on individual systems dealing with security and defensive issues in the absence of an integrated system. Nor is it reasonable to assume that the testing of an integrated BMDS would lead to nuclear proliferation any more than other general U.S. international policies and positions.
BMDS	F0005-11	For example, the PEIS projects 515 BMDS launches over the next decade. The sheer volume of this many launches dwarfs the number of projected government and commercial launches over the same period, and the volume of solid rocket propellant involved will generate large quantities of hydrogen chloride, which reacts in the atmosphere to create acid rain.	The PEIS considers the conservative scenario of conducting up to 515 BMDS-related launches over the ten-year period. This would include launch of interceptors and targets. Appendix I of the PEIS provides the background information used to determine the potential cumulative impacts from BMDS launches. This appendix provides the total amount of hydrogen chloride expected to be released from up to 515 BMDS launches. The PEIS finds that the emission loads of chlorine (from hydrogen chloride and free chlorine) from both BMDS and other launches worldwide would account for only 0.5 percent of the industrial chlorine load from the U.S. alone over the same 10 year period. The cumulative impacts analyses of the BMDS implementation alternatives are provided in Sections 4.1.4 and 4.2.3 of the PEIS.

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BMDS	PHO0044-4	Probably the most serious problem is that this document is largely irrelevant. As the summary in Section 1.2 indicates, environmental analyses have been done for most of the components already. Notable exceptions are sea-based midcourse defense and space weapons, which to my knowledge have not been analyzed.	The PEIS examines the potential environmental impacts of MDA's concept for developing and implementing an integrated BMDS, based on Congressional and Presidential direction. The PEIS provides the framework for analyzing the development, testing, deployment, and planning for decommissioning of the BMDS. As Section 4.2.1 of the PEIS states, the potential impacts associated with the use of space-based interceptors are considered in the PEIS and additional environmental analyses would be conducted as needed when the technologies intended to be used become more defined and robust. Aegis BMD operations are addressed in the PEIS to the same extent as other ballistic missile defense programs. As detailed in the PEIS the individual program elements while developed individually historically are now undergoing integration testing to provide a layered BMDS capable of destroying all ranges of threat missiles in all flight phases. Specific test locations and activities are not analyzed in this PEIS; however, MDA routinely considers all test activities, including those involving Aegis BMD as player or watcher, to determine and prepare the requisite level of NEPA analysis. MDA will continue to consider the environmental impacts of its testing programs tiering from the PEIS, as appropriate.
BMDS	PHO0044-5	R&D and testing of most of the components is well underway and decisions have mostly been made about these systems, including even decisions about the initial	See previous response.

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		deployment of the ground-based midcourse defense and the sea-based midcourse defense.	
BMDS	PHW0001-2	The system being deployed has no demonstrated capability against a real attack and is missing most of its major elements, including (l) the X-Band radar; (2) the satellite constellations SBIRS-High and SBIRS-low (the-latter now called STSS), and (3) adequate discrimination capability by its exo-atmospheric kill vehicle interceptor, the EKV, which is also missing. The inescapable conclusion is that the Administration is deploying a system that doesn't work and hasn't been adequately tested. Moreover, it will not have the capability even theoretically to protect much of the United States.	The deployment of an initial defensive capability referred to as Initial Defensive Operations (IDO) or Initial Defensive Operations Capability (IDOC) has been considered in previous NEPA documents including the GMD IDOC at Vandenberg Air Force Base (AFB) EA and the National Missile Defense (NMD) Deployment EIS. Subsequent decisions regarding deployment of an initial defensive capability have been made based on these analyses as documented in the GMD IDOC at Vandenberg AFB Finding of No Significant Impact and the GMD IDOC at Ft. Greely ROD (based on the NMD Deployment EIS).
BMDS	PHW0002-2	Alternative 2, which includes the usage of space-based interceptors (SBIs), is questionable for many reasons. It looks at the effect of using space-based interceptors in lieu of terrestrial-based ones; however, the BMDS that is repeatedly envisioned by MDA and Pentagon officials is one where targets would be engaged at all stages in their flight, from all types of launch platforms. To look only at the usage of an SBI is to willfully ignore the concept of operations that has been used to justify this massive defense system. The American Physical Society, in its boost-phase intercept study released in July 2003, estimated that a constellation of at least 1000 SBIs would be required to provide a minimal defense against liquid-fuelled ICBMs. Granted, testing would be of a much lesser nature than a complete constellation, but at some point presumably the system would be tested at some	In Alternative 2 the PEIS considers the use of weapons from land-, sea-, air-, and space-based platforms. Because the analysis of impacts of using weapons from land-, sea-, and air-based platforms was considered in Alternative 1, the PEIS focuses on the impacts of using weapons from space-based platforms in the discussion of Alternative 2. These impacts would be in addition to those impacts for Alternative 1, as was stated in the first paragraph of Section 4.2 of the PEIS. Section 4.2.2 considers the potential environmental impacts from System Integration Tests using land-, sea-, air-, and space-based platforms for weapons, sensors, C2BMC, and support assets. The PEIS considers the impacts of the proposed BMDS as currently envisioned over a period of ten years. Other actions that are outside this evaluation period are outside of the scope of this PEIS and would need to be considered in future analyses.

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Issue Topic	Comment Number	Excerpt Text	Response
		fraction of its full strength. This draft PEIS does not take into consideration that possibility.	
BMDS	F0004-3	2 You have said in the past year that there are NO longer plans to install Missile Silos on Kodiak. Keep that Plan. No Silos...Period. You must keep your word true to us citizens. After all its OUR Home + Our Program too.	The PEIS does not address specific locations for BMDS assets for the implementation alternatives; it provides examples of test locations so that resources can be examined for the potentially affected environment. At this time, the MDA has no plans to construct/operate silos at KLC.
BMDS	PHO0023-4	The same with the Airborne Laser. There is a very good probability that an Airborne Laser would never work in shooting down a missile in the boost phase and all tests indicate that. But it could be highly effective in a directed energy targeting on Earth for terrestrial targets. And you should be honest about what that weapon might also be used for. It would be helpful to actually not mask the true purposes of some of these weapons.	The ABL is designed to intercept threat missiles in the boost phase of flight. The ABL would be deployed to and operate in areas where boost-phase intercepts could be attempted. Its effectiveness is undergoing thorough testing as an integral component of the BMDS boost phase defense. The MDA has no plans to use the ABL for terrestrial targets.
BMDS	E0162-3	1) The PEIS should give quantitative information on the reliabilities of the boosters to be used to launch targets for BMDS tests. I noted in my scoping comment (See first comment on page B-15 of the draft PEIS.) that I had asked for this information in my comments on the 1994 BMD draft PEIS and that the response was inadequate for any meaningful assessment of the risks from launch failures. This information is especially important to include in the PEIS because the same target boosters are used in various test programs and because the information has not been included in previous environmental analyses. I noted in my comments on the 2003 GMD ETR draft EIS that an analysis of Minuteman test launches found a rate of severe failures of 15% and that the Strategic Target System has had one serious failure (9 Nov. 2001 launch from Kodiak)	Booster reliability is considered for individual tests. The range or facility safety personnel at the locations of the testing calculate the impact zones for intercept debris as well as impact areas where a non-nominal or errant target or interceptor would impact. These calculations consider the impact areas including the effects of the use of a flight or thrust termination system or other safety measures. In addition, strict range/facility safety procedures required by each range/facility would be adhered to. The MDA uses many different boosters in its testing program and the risk associated with any specific booster would be assessed and addressed by range or facility safety personnel prior to a test.

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		in five launches. Including my scoping comment in exhibit B-9 as a health and safety issue seems to imply that this aspect should be analyzed in the PEIS. At the 26 Oct. public meeting in Honolulu, I was assured that including booster reliability information would be considered.	
BMDS	F0005-15	1) In order to evaluate the risks from launch failures, the PEIS should give qualitative information on the reliabilities of the boosters to be used to launch targets for BMDS tests.	See previous response.
BMDS	E0162-6	4) Page D-15 of the PEIS contains misleading information about previous NEPA analyses related to Aegis BMD. It cites the 1998 PMRF Enhanced Capability EIS as a supporting NEPA analysis. In fact, this EIS explicitly excluded the Navy Theater-Wide System (now called Aegis BMD) from evaluation. No subsequent environmental analysis has been done even though Aegis-LEAP tests have been done near PMRF. The PEIS should indicate when environmental analyses of this system will be done. Press reports have indicated that 20 sea-based midcourse interceptors are scheduled for deployment in 2005. The PEIS states on page D-19 that three Aegis BMD cruisers and 15 Aegis BMD destroyers would be available for deployment at the end of Block 2004.	As noted in the 1998 Pacific Missile Range Facility (PMRF) Enhanced Capability EIS, the Theater-Wide system would be designed to engage missiles at long-range and high altitude (outside the atmosphere) and to protect a very large area (theater). This capability is especially important if the attacking missile is carrying a nuclear, chemical, or biological warhead. The Theater-Wide program would provide vital political and military assets, supporting infrastructures, population centers, and entire geographic regions with timely and extensive protection against medium/long range Theater Ballistic Missiles. Operating in international waters, forward deployed ships equipped with the Navy Theater-Wide Theater Ballistic Millise Defense system would have the capability to engage Theater Ballistic Missiles early in their ballistic missile trajectory. Multiple ships operating in mutual support would be capable of providing the layered defense and overlapping coverage that lead to improved levels of protection. It was determined that the Theater-Wide program was not sufficiently developed to be evaluated in the 1998 document. However, Aegis

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Issue Topic	Comment Number	Excerpt Text	Response
			Lightweight Exoatmospheric Projectile intercept tests are designed to assess interceptor missile operations outside of the atmosphere. These tests were analyzed in the 1998 EIS.
BMDS	F0005-18	(4) The PEIS should indicate when an environmental analysis of the Aegis BMD system will be done. The earlier EIS relied upon at page D-15 contains misleading information.	See previous response.
BMDS	E0162-12	10) The brief history of U.S. missile defense activities in section 1.2 excludes any mention of critical technical analyses of components and testing of them. For example, the 1998 report of the Pentagon panel headed by Gen. Welch characterized the inadequate preparation for flight tests as a "rush to failure." Two GAO reports in 2003 (GAO-03-441 and GAO-03-600 available at www.gao.gov) questioned the adequacy of testing and readiness for NMD deployment. The May 2004 report Technical Realities (available at www.ucsusa.org/global_security/missile_defense/index.cfm<http://www.ucsusa.org/global_security/missile_defense/index.cfm>) by the Union of Concerned Scientists provided a critical analysis of the NMD system being deployed. It is noted on page 1-7 that Pres. Bush's 17 Dec. 2002 decision to deploy an initial defense capability followed "continued test bed development and successful flight test activities." It should be added that this decision followed by six days a test failure and that the test record so far is five intercepts in eight attempts.	These comments have been noted for the record. Section 1.2 of the BMDS PEIS is intended to provide the reader with a brief history of U.S. missile defense activities. The PEIS is a programmatic level analysis of potential environmental impacts associated with the implementation alternatives identified for the proposed BMDS. It does not address DoD threat assessment policy-making issues or the technological feasibility of missile defense system design. Appendix D of the PEIS was intended to provide the reader with a very brief historical perspective on the past development including relevant NEPA analyses, of various DoD programs whose components are being considered for integration into the proposed BMDS. The specific numbers of intercepts or failures of previous Aegis LEAP tests are not relevant to the consideration of environmental impacts from the system integration testing of the proposed integrated BMDS. As specific Aegis BMD components take part in specific system integration tests, analysis of environmental impacts will be analyzed in NEPA documents appropriately tiered from this PEIS.

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Issue Topic	Comment Number	Excerpt Text	Response
BMDS	E0162-13	11) The brief history of the Lightweight Exoatmospheric Projectile (LEAP) program on page D-17 states that tests in the early 1990's showed that LEAP "could be integrated into a sea-based tactical missile for ballistic missile defense." In fact there were no successful intercepts in five attempts in these tests. Two successful Aegis LEAP intercept tests in 2002 are described but there is no mention of the intercept failure on 18 June 2003. The Aegis LEAP test record so far is four intercepts in five attempts.	See previous response.
BMDS	E0162-14	12) It is stated on page D-40 that there were eleven THAAD flight tests in the 1990s and that, "Upon successful intercept, the THAAD program began planning to validate the performance capability and overall effectiveness of the THAAD element, flights tests, and intercepts of target missile launches over more realistic distances..." Of the eight intercept attempts in the 1990's tests, there were only two hits.	See previous response.
BMDS	E0319-11	The PEIS should include all proposed laser test sites including the BOA, and, what experiments will take place at each site, and the total amount of acreage needed as a safety zone. For example, will the Airborne Laser 'test fire' at targets or interceptors launched from Vandenberg AFB, Kwajalein, Kodiak Island, Fort Greeley, or Poker Flats Rocket Range, Alaska?	The PEIS does not address specific locations for BMDS assets for the implementation alternatives; it provides examples of test locations so that resources can be examined for the potentially affected environment. If future plans identify specific locations that are required to support laser activation tests, they would be considered in subsequent tiered NEPA analyses.
BMDS	E0319-14	Draft PEIS Volume 2, pages D-25, D-26 (Exhibit D-6) states Ground-Based 'Interceptors' will be launched from the Kodiak Launch Complex (KLC), Alaska. In the Fall of 2003, a press release by the MDA stated only target missiles, not interceptors would be launched from the	The GMD ETR EIS did analyze the environmental impacts of launching interceptors from KLC. As the commenter correctly states, the MDA announced in a ROD that there were currently no plans to launch interceptors from KLC. This is still the case. The information presented in Appendix D has been corrected

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Issue Topic	Comment Number	Excerpt Text	Response
		KLC. No previously released EAs or EISs have included plans for launching interceptors from Kodiak Island.	in the Final PEIS to reflect that there are currently no plans to launch interceptors from the KLC.
BMDS	E0395-11	The PEIS states that space-based interceptors could be placed in geosynchronous orbit: 35,786 kilometers above the Earth's surface. To actually get a weapon from geosynchronous orbit to low-Earth orbit or even a lower trajectory of a missile within 20 minutes or half hour and do so accurately is physically impossible. Therefore the PEIS has mischaracterized this space weapon. Simply, any weapon placed in geosynchronous orbit could not be an anti-missile weapon. However such a deployment could be an anti-satellite weapon, an ASAT. The agency should then go through the process of trying the field this ASAT weapon on its own merits.	The BMDS PEIS states that space-based platforms for sensors or C2BMC could be placed into Geosynchronous Earth Orbit (GEO); however, there is no mention of placing space-based platforms for weapons into GEO. If future plans were to identify the need for the use of space-based platforms for weapons in GEO, they would be considered in subsequent tiered NEPA analyses, as appropriate.
BMDS	PHO0023-3	The other thing I want to bring up is in regards to in the PEIS there is some statements in the effect that some of the space-based interceptors would be placed in geosynchronous orbit, which I believe is some 24,000 kilometers from Earth. To actually get a weapon from 24,000 kilometers out to what would be a low-Earth orbit or even a lower trajectory of a missile within 20 minutes or half hour and do so accurately and to hit the missile is fantasy. And therefore I think the PEIS mischaracterizes any weapon that would be placed in geosynchronous orbit as being an anti-missile weapon. It should simply not be listed as a possibility. That would be -- well, you would be deploying an ASAT -- an anti-satellite weapon. And you should go through the process of actually fielding that before the public and have -- and take your hits for that if, indeed, you're doing that.	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
BMDS	E0395-12	With respect to the Airborne Laser, the PEIS says that, "the ABL is currently the only proposed BMDS element with a weapon using an air platform." This is not correct. The PEIS should also address another proposed BMDS element using air platforms, namely, interceptors fired from aircraft.	At this time there are no plans to use any weapons other than the ABL from air-based platforms to support the BMDS. If future plans were to identify the need to use other weapons from air-based platforms, they would be considered in subsequent tiered NEPA analyses, as appropriate.
BMDS	PHO0026-1	The Airborne Laser is currently the only -- emphasize only -- proposed BMDS element with a weapon using an air platform, closed quotes. However, the PEIS does not discuss another proposed BMDS element that would use air platforms; namely, interceptors fired from aircraft.	See previous response.
BMDS	E0395-16	A third interceptor site is mentioned in the PEIS but it's location is not stated or described. More importantly, the environmental impact of BMDS operations at that third site are not addressed either. MDA officials have said that this third site could hold up to 20 ground-based interceptors and be bigger than the site at Fort Greely, Alaska. The environmental impacts of such as large operation should be addressed.	The PEIS does not address specific locations for BMDS assets for the implementation alternatives considered in the BMDS PEIS; rather it provides location types so that resources can be examined for potentially affected environments. As the BMDS is a defense system undergoing constant scrutiny for improvement, there could be additional locations for various components being considered at stages too preliminary for NEPA analysis. As additional locations or facilities are identified as necessary to support the BMDS, they would be considered in subsequent NEPA analyses tiered from the PEIS, as appropriate.
BMDS	E0401-1	I would like to raise the issue of the 3rd ground-based interceptor site, something which I believe has been completely overlooked in the draft Ballistic Missile Defense System Programmatic Environmental Impact Statement. There is no hard and fast information in this document which indicates where the 3rd interceptor site may be located. However, news stories this fall claim that the United States has been discussing with the United	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
		Kingdom the possibility of basing our interceptors on their territory. Alternatively, there are reports that Poland may be the host of the third site. Be that as it may, the draft PEIS gives no indication of where the third site will be, nor of the extent of its size. Presumably, if this document is to lay the groundwork for the missile defense network in its entirety, at least several of these alternatives would have to be examined.	
BMDS	PHO0011-4	The environmental consequences of mini rocket launches needed to deploy and maintain space-based interceptors has not been adequately considered, nor has the environmental consequences of the fuel. They talk about having all of the -- these -- in other words, in Option 2, they have many different interceptors in space that would have a reduced environmental consequence. But there's no consideration you have to launch all of those missiles in the place to get there.	As stated in the BMDS PEIS (Section 2.2.4 Support Assets), the launch vehicles used to insert space-based platforms into the proper orbit would likely be existing launch vehicles; and therefore, the impacts of launches to deploy and maintain BMDS assets in space would be as described for Support Assets.
BMDS	PHO0037-4	Another concern is that it didn't really look at the many rocket launches that are needed to test and deploy and maintain the space interceptors.	See previous response.
Decommis-sioning	M0268-2	When it comes time for decommissioning the military often finds it does not have the technology, or the funds required, to clean up damaged sites. This has certainly been true of other complex systems, like those involving chemical and nuclear weapons. In those cases there is still uncertainty about how to safely destroy or store decommissioned weapons and the associated toxic wastes. MDA needs to address these questions satisfactorily in advance. We suspect they are not addressed because costs involved would be prohibitive and in some cases the technology for disposal does not exist.	Section 4, Environmental Consequences, Decommissioning Phase Activities, of the PEIS states that environmental impacts associated with decommissioning of specific components would be more appropriately addressed in subsequent tiered environmental analyses. However, this section provides a roadmap for considering the impacts of decommissioning for each component. Future tiered analyses would consider specific environmental impacts related to decommissioning individual components as appropriate.

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Issue Topic	Comment Number	Excerpt Text	Response
Radar	PHO0038-2	I remember from last time, part of about the radar, somebody from Valdez was worried about that it was going to set off airbags in cars, set off fire extinguishers, some kind of weird effects of the radar, but I didn't see any mention of that in there and I didn't get a chance to read the whole thing.	Potential health and safety impacts of radars are outlined in Section 4.1.1.3 of the document. The MDA has found no indication that effects of EMR would include setting off vehicle airbags or initiating fire extinguishers.
Radar	E0402-2	None of the X-band radars that are central to the system are built hence we are exposing ourselves and the world with a system that has no hope of working.	As noted in Section 2.2.2, the BMDS would consist of three different types of sensors: weapon/element sensors, BMDS mission sensors, and test range telemetry sensors. The BMDS mission sensors would provide information for missile warning, early interceptor commit, in-flight target updates, and target object maps. As part of a layered and integrated system, numerous sensors would be used to direct and track threat missiles; direct interceptors or other defenses; and assess whether a threat missile has been destroyed.
Radar	M0161-1	In addition, the Administration's missile defense system lacks a key component: the X-band radar intended to track incoming warheads and help guide the interceptors to their targets.	See previous response.
Radar	M7806-1	It is also my understanding that the deployment is being made without the radar system because it is faulty. How, might I ask will a missile be guided?	See previous response.
Sensors	E0142-1	Very briefly, it is my perception that the state of the art in automatic image analysis is such that reliable object recognition is possible only in well-controlled environments wherein the quiescent illumination, the clutter, and preferably the orientation of the target object are under control. These environmental constraints obviously cannot be imposed on a ballistic missile defense system, and therefore one should be very skeptical of	Sensors would be tested to evaluate performance in detecting and tracking threat ballistic missiles. Tests would use targets of opportunity as well as BMDS targets. Performance would be evaluated by comparing observed and predicted performance of the test sensor's ability to detect the target, accurately measure and track the target, and discriminate the reentry vehicle from countermeasures. Generally, components would be

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Issue Topic	Comment Number	Excerpt Text	Response
		claims that enemy missiles can be reliably identified. To the extent that the proposed system depends on automatic detection of enemy missiles, it is very unlikely that it will be reliable, given the present state of the art.	deployed after sufficient testing to demonstrate that they are capable of operating successfully within an integrated BMDS.
Weapons	E0387-4	Missile Defence plans extend to the possible deployment of space-based weaponry and space-based weapons systems. It is crucial that the PEIS consider seriously the likely impact of space weapons deployment. The use of space weapons, for whatever reason, to attack or destroy objects outside of the atmosphere would produce space debris, changing the near Earth environment and would become a serious hazard to future space missions, even possibly preventing them from leaving Earth. At the speeds required to escape the Earth's gravitational pull, the impact of just a tiny object on a space rocket could be disastrous. Space-based conflict of any sort could add to this problem enormously and it is an issue that deserves serious attention.	The impacts from the use of space-based weapons are considered in Sections 4.2.1 and 4.2.2. This analysis includes consideration of orbital debris that would be produced as a result of placing and testing weapons in space. MDA has added Technical Appendix L to the Final PEIS to discuss orbital debris issues more fully.
Deployment	E0395-8	In the statement read by Mr. Marty Duke at the Public Hearing held in Sacramento on October 19, 2004, Mr. Duke said that if testing failed to show that the system worked, the system would not go forward. However, as you know, the system is already being deployed even though it has no demonstrated capability to work under realistic conditions. Accordingly, the environmental process described in this PEIS is not believable since the statement made by Mr. Duke on October 19 has already been nullified by the Missile Defense Agency.	The MDA has not made a decision on how to implement the BMDS. The commenter is referring to a decision made by President Bush explained in Section 1.2 of the PEIS to implement an initial defensive capability to protect the U.S. Homeland. This decision in itself does not constitute a decision on how to configure or deploy the BMDS. The statements made at the public hearing which are available on the MDA PEIS web site are accurate and constitute the MDA's current acquisition strategy which allows for reviews of a proposed component's operational feasibility during all life cycle phases of the component's development.

Exhibit K-3. Responses to Comments – Environmental Impacts

Issue Topic	Comment Number	Excerpt Text	Response
Airspace	E0402-7	4) The risk of accidental missile launching to civilian or military aircraft is a real concern. The window of opportunity for successful launch is too narrow given its unproven track record, that the target identification is inadequate. This will result in incredible toxins being released as aircraft contain fuel, sometimes depleted uranium ballast, among other cargos not to mention the deaths of innocent victims.	BMDS testing activity would be limited to areas of restricted range and airspace. Before testing is conducted, range areas would be cleared and NOTAMs would be issued to the public. Airspace designations would be such that even in the event of an anomaly, debris would not pose a danger to health and safety. The PEIS does not consider the impacts to airspace during an actual threat missile launch and subsequent use of the system.
Airspace	PHO0011-2	While the BMDS states that warning will be provided to enable time to clear the air space, it's highly doubtful that such time would be allowed in such an emergency.	See previous response.
Biological Resources	E0030-2	10) The environmental effect of the X-band radar upon people and birds have not been thoroughly studied.	The environmental impacts of radar, including radar operating within the X-band, on birds is considered in Section 4.1.1.1 of the PEIS. In addition, the PEIS incorporates by reference previous NEPA studies in which the potential impacts of radar activation on biological resources are considered (see Appendix N of the PEIS).
Biological Resources	F0004-5	4 Dropping Rocket booster stages anywhere along the east side (or interior) of Kodiak Island is totally unacceptable! It is all critical habitat area for the endangered Steller Sea Lions. There are numerous haul-outs + rookeries all along the Coast of the Kodiak Archipelago. We commercial fisherman have severely shut down from fishing near any of these places So...you can't disturb them either! If you kill any off we get the blame, and we will be shut completely down from fishing! Please consider our fate to make a living ok.	The site-specific detail of this comment cannot be appropriately considered in this type of programmatic environmental analysis. However, additional text has been added to the Final PEIS to explain that meetings with the USFWS and National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service occurred. Additional information about possible impacts to biological resources from launch debris including booster stages impacting land and water are considered in Section 4.1.1.2 of the PEIS.

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Issue Topic	Comment Number	Excerpt Text	Response
Biological Resources	PHO0010-1	But the truth is over the decade life of the program, the global level of perchlorates may rise. Amphibians skin needs to be moist. They're very sensitive to all industrial chemicals. Seventy percent of the species are in decline right now, even in habitats that aren't disturbed. Why would we care about them? The mosquitos are coming out. We don't have hard figures. We don't have real analysis. We're told this is a half a percent. What they're disguising there is most of the chemicals are residual from former manufacturing processes. And even so, the largest contributor -- as a scientist, I'm simply telling you, the largest contributor actually is the manufacturing, testing, open detonation of old rocket motors and the whole thing.	Historically, the manufacturing and disposal of solid rocket propellant that contains ammonium perchlorate as an oxidizer has led to perchlorate contamination. There is no evidence to suggest that burning solid propellant in a solid rocket motor (SRM) leads to emissions of perchlorate to the atmosphere. Perchlorate could be released into the environment in the form of uncombusted solid rocket propellant from a non-nominal launch or other accident causing release of solid propellant to land or water. These have been considered in the PEIS. Additional information on perchlorate has been added to the PEIS text as well as a technical appendix (Appendix M) on perchlorate. This appendix considers the uses, sources, and disposal of perchlorate as well as the human health and ecological risk of exposure to perchlorate.
Cultural Resources	PHO0051-8	Hawaiian burials and sacred sites are desecrated by the missile launches and Star Wars facilities, while cultural practices and subsistence access rights are denied due to base security measures.	The PEIS analyzes the programmatic development, testing, deployment, and planning for decommissioning activities for an integrated BMDS. Specific facilities that would be used to carry out subsequent activities comprising the life cycle phase testing would be analyzed in site-specific documents. These subsequent NEPA analyses could tier from this PEIS, as appropriate.
Cumulative Impacts	E0162-5	3) The PEIS discussion of cumulative impacts in section 4.1.4 and Appendix I has no details about the location, schedule, and specific missiles to be used for the estimated 515 launches from 2004 to 2014. This is important because there are annual limits on the numbers of launches at the Pacific Missile Range Facility (PMRF), Kodiak, and Vandenberg AFB, as noted in the GMD ETR EIS. The GMD ETR EIS estimated 10 launches per year	The PEIS is a programmatic level NEPA analysis that considers implementation alternatives for an integrated BMDS. The PEIS considers the program as a whole to allow tiering of subsequent site-specific analyses from the PEIS and as such does not address specific sites or specific activities at those sites. Launches occurring from site-specific locations would not exceed annual launch limits established by the range.

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Issue Topic	Comment Number	Excerpt Text	Response
		so the PEIS needs to give some details about the additional 415 launches. Some information about future launches for tests of some BMDS components is provided in Appendix D. However, there are no estimates for Aegis BMD tests and only vague estimates for GMD tests. For example, it is stated on page D-25 that, "GMD test plans include a number of missile-launches (interceptors and/or targets) from each launch facility per year." The PEIS should also include impacts of test launches of offensive missiles. For example, tests of the Trident D5 are reported to be planned near PMRF in 2005.	The number of launches considered in the PEIS includes not only the launch of ground-based interceptors (GBIs), but also the launch of targets and other missiles used in testing individual components of the BMDS and system integration flight testing. As stated in Section 2.1, the BMDS is designed to negate threat ballistic missiles and thus is comprised of multiple defensive weapons. The BMDS is not designed to be an offensive system. Test assets, such as targets, that would be used to test BMDS components have been included in the 515 projected launches that were analyzed to determine the cumulative impacts of BMDS launches.
Cumulative Impacts	E0319-20	Page 4-112, Section 4.1.4-Cumulative Impacts, does not give any useful or detailed information regarding the 515 projected BMDS launches during 2004-2014. The PEIS needs to include a breakdown of the 515 proposed launches and where each launch will take place (ground-based, sea-based, and space-based test locations). Where did the MDA come up with the 'magic' number of 515? A total of only 10 launches per year have been proposed from the KLC in previous EA documents (Air Force, Army). The MDA needs to validate and justify the need for 515 launches, considering the fact that 'Emissions from activities for the proposed BMDS include carbon monoxide, sulfur oxides, nitrogen oxides, volatile organic compounds, hazardous air pollutants, and particulate matter'. 'Most sites where activities for the proposed BMDS may occur would be classified as a major emissions source' (BMDS Draft PEIS Volume 2, pages H-18- H-19-Existing Emission Sources)	The PEIS is a programmatic level NEPA analysis that considers implementation alternatives for an integrated BMDS and as such does not address specific sites or specific activities at those sites, but rather considers the program as a whole to allow tiering of subsequent site-specific analyses from the PEIS. As the cumulative consideration of launches is global, the specific launch sites are in fact not needed to consider the cumulative impacts of these launches on global warming or ozone depletion. Launches occurring from site-specific locations would be analyzed as appropriate to ensure that either individually or cumulatively they would not exceed local emissions thresholds or limitations in specific areas. Appendix I notes that as indicated in Ross, 1998 although ozone loss occurs in the plume wakes of the largest solid propellant boosters, the amount and

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			duration of the loss appears to be temporary and limited. In addition, the cumulative impact from launch emissions has been shown to be insignificant when compared to other sources of greenhouse gases and ozone-depleting substances. Impacts from launches occurring from sites in the Arctic Tundra or the Sub-Arctic Taiga Biomes would be addressed in subsequent site-specific analyses tiered from the PEIS, as appropriate.
Cumulative Impacts	F0005-17	(3) The PEIS discussion of cumulative impacts in Sec. 4.1.4 and Appendix 1 contains no details about the location, schedule, and specific missiles to be used for the estimated 515 launches from 2004 to 2014. They are essential.	See previous response.
Cumulative Impacts	E0319-21	The MDA's own admission in the Draft PEIS confirms the fact that: "Launches can contribute to cumulative impacts including ozone completion, global warming, and orbital debris, which could affect global warming and depletion of the stratospheric ozone layer (Volume 2, page I-2-Cumulative Impacts). The MDA must discontinue all future BMDS test plans which will contribute to further global warming or contamination in the affected Biomes listed in the PEIS; especially the Arctic Tundra Biome and the Sub-Arctic Taiga Biome-which includes areas of the Aleutian Chain where various radars or sensors are activated or will be activated as part of the proposed BMDS (e.g. Adak Island where the Sea-Based X-Band Radar will be home-ported, Shemya Island where the COBRA DANE is located, and the BOA in the Gulf of Alaska).	It was shown in Ross, 1998 (as referenced in Appendix I of this PEIS) that although ozone loss occurs in the plume wakes of large solid propellant boosters, the amount and duration of the loss appears to be temporary and limited. In addition, the cumulative impact from launch emissions has been shown to be insignificant when compared to other sources of greenhouse gases and ozone-depleting substances. Impacts from launches occurring from the Arctic Tundra or the Sub-Arctic Taiga Biomes would be addressed in subsequent site-specific analyses, as appropriate.

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Cumulative Impacts	E0427-20	19) The BMDS PEIS needs to consider direct, indirect and cumulative effects of the proposed project in conjunction with other federal offensive military weapons systems and policies were not addressed, but need to be addressed. The National Environmental Policy Act (NEPA) (http://ceq.eh.doe.gov/nepa/regs/nepa/nepaeqia.htm) and especially the Regulations for Implementing NEPA (http://ceq.eh.doe.gov/nepa/regs/ceq/toc_ceq.htm), state that both the direct and indirect effects of the proposed project as well as the Cumulative impact of the project should be considered. Sec. 1508.7 States that the "Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. In the context of this global ballistic missile defense system, the cumulative impact of reasonably foreseeable future actions of the US as well as other nations, agencies and persons need to be considered. Yet the reasonable foreseeable actions of other nations and individuals responding to the BMDS by proliferating WMD was not considered by the MDA in this PEIS. As stated in Sec. 1508.8 "Effects" include:(a) Direct effects, which are caused by the action and occur at the same time and place and (b) Indirect effects, which are	BMDS weapons components are considered defensive weapon system components that would be used to destroy threat missiles. The projected BMDS launches used to calculate the cumulative impacts of launch emissions include targets that would be used to test various BMDS components. The PEIS considered all potential environmental effects including cumulative effects of implementing a proposed BMDS from a programmatic standpoint. The argument that the proposed BMDS would lead other nations to proliferation of weapons of mass destruction is the opinion of the commenter; and as such MDA does not consider it a reasonably foreseeable action to be considered in the PEIS. As shown in Appendix I, foreign military launches were included in the cumulative impacts analysis to consider impacts on global warming and ozone depletion.

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		caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Effects and impacts as used in these regulations are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial. Thus, by law the MDA also needs to consider the Direct, Indirect and Cumulative impacts on the environment of the proposed BMDS along with other US offensive weapons systems and stated & demonstrated US preemptive first-strike policy.	
Cumulative Impacts	E0429-10	At least by number, the 515 projected BMDS launches over the decade beginning this year dwarfs the 99 other projected government launches and the 77 estimated U.S. commercial launched anticipated over the same time period. The environmental review of such a large system, to be developed over a period of many years and potentially deployed for decades, provides an opportunity to reconsider the technologies that our country uses for launching rockets. The draft Programmatic Environmental Impact Statement ignores that opportunity.	Section 4.1.4 shows that BMDS launches are only three times the amount of non-BMDS U.S. launches instead of five times the amount as indicated by the commenter. While projected BMDS launches may account for more launches than other U.S. launches, the size of the BMDS boosters would be on average much smaller than those used for other U.S. launches. Boosters were classified into ranges based on the size of the propulsion system. As shown in Exhibit I-2 of Appendix I of this PEIS, all of the 515 projected BMDS launches fall within the low propellant weight category. Therefore emission loads to the stratosphere from BMDS projected launches (shown in Exhibit I-6) are less than those for other U.S. launches (shown in Exhibits I-7 and I-8).

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			The BMDS PEIS considers the use of a wide variety of propellants including three types of boosters, pre-fueled liquid propellant, non-pre-fueled liquid propellant, and solid propellant boosters. The environmental impacts of the use of each of these three types of boosters are presented in Section 4.1.1.2 of the PEIS.
Cumulative Impacts	PHW0004-10	At least by number, the 515 projected BMDS launches over the decade beginning this year dwarfs the 99 other projected government launches and the 77 estimated U.S. commercial launched anticipated over the same time period. The environmental review of such a large system, to be developed over a period of many years and potentially deployed for decades, provides an opportunity to reconsider the technologies that our country uses for launching rockets. The draft Programmatic Environmental Impact Statement ignores that opportunity.	See previous response.
Cumulative Impacts	E0429-13 and PHW0004-13	Once again, the PEIS acknowledges this environmental impact, but it plays it down: "The cumulative impact on stratospheric ozone depletion from launches would be far below and indistinguishable from the effects caused by other natural and man-made causes." (page 4-114). I appreciate the data presented in Appendix I, but the conclusion reached by the authors is implausible.	As indicated in the PEIS on page 4-114, the chlorine emissions from projected BMDS launches during 2004-2014 is a very small fraction (.05%) of the total chlorine emissions from U.S. industrial sources during that same 10-year period. This does not account for emissions of chlorine from natural causes or from sources throughout the industrialized world, only U.S. industrial sources. Therefore, it is completely plausible that the cumulative impact from BMDS launches on stratospheric ozone depletion would be far below and indistinguishable from chlorine emissions from other natural and man-made causes.
Cumulative Impacts	E0429-14 and PHW0004-14	However, the industrial "emissions" are actually the residuals of production and use of chemical which have been phased out, under the Clean Air Act Amendments of	As the commenter states, production and use of ozone depleting substances are being phased out. The production of the most destructive ozone depleting

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		1990 and a series of international protocols. That is, these substances are already in the environment; nothing can be done to put them back in the bottle. Thus, each year stratospheric releases of rocket fuel exhaust become a larger fraction of the problem, as fewer industrial ozone-depleters are manufactured. More important, the fractional contribution of rocket-launches to ozone depletion does not make it desirable. It is as large as all but the largest industrial releasers, before the phase-out took effect, and orders of magnitude larger than the releases from a home refrigerator or a car air conditioning system. Our environmental laws and policies do not excuse pollution simply because there are other, larger sources. That is, if I were a repairer of air conditioning systems, I could not-and should not -release chlorine-containing refrigerants into the atmosphere simply because a Titan or Delta launch vehicle emits much more chlorine.	substances (Class I substances) has already ended and the production (for domestic use) of Class II ozone depleting substances (which are less destructive than Class I substances) is slated to end by 2030. However, it is expected that emissions of Class I compounds will continue, albeit in ever decreasing amounts, for many more years. The emissions of Class II compounds are expected to increase until many years after the phase-out of these substances is complete. ("Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2001," U.S. EPA 430-R-03-004, April 2003). Therefore, it is unlikely that there will be dramatic decreases in the emissions of the ozone depleting substances for many years and thus rocket emissions will continue to comprise an insignificant fraction of these emissions for the next several decades. Because rocket emissions are released directly into the stratosphere at elevated temperatures, they do not behave exactly like emissions of ozone depleting substances released into the troposphere. Studies have found that although rocket exhaust emissions can cause immediate loss of ozone in individual plumes, the emission plumes from these rockets disperse in a way that makes it highly unlikely these ozone losses will impact areas near launch sites, even with launches of the largest solid rockets. In addition, measurements of rocket plumes from vehicles much larger than those proposed for BMDS have shown that "the amount of ozone destruction does not increase without limit" (i.e., the amount of emissions is not necessarily directly proportional to the amount of ozone

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			depletion). Ozone loss has also been shown to slow about one hour after launch, suggesting that the most ozone-destructive emissions have been deactivated by reactions with various gases in the surrounding air and that the duration of the impact of these emissions is fairly short, especially compared to other ozone depleting substances that persist for many years in the stratosphere. Based on this and other related research, the Air Force and the entire space-launch community are "confident that ozone loss from both individual and collective launches does not constitute a significant environmental hazard." (http://www.aero.org/publications/crosslink/summer2000/01.html)
Cumulative Impacts	E0439-20	19) The BMDS PEIS needs to consider direct, indirect and cumulative effects of the proposed project in conjunction with other federal offensive military weapons systems and policies were not addressed, but need to be addressed. The National Environmental Policy Act (NEPA) (http://ceq.eh.doe.gov/nepa/regs/nepa/nepaeqia.htm) and especially The Regulations for Implementing NEPA (http://ceq.eh.doe.gov/nepa/regs/ceq/toc_ceq.htm), state that both the direct and indirect effects of the proposed project as well as the Cumulative impact of the project should be considered. Sec. 1508.7 States that the "Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually	BMDS weapons components are considered defensive weapon system components that would be used to destroy threat missiles. The projected BMDS launches used to calculate the cumulative impacts of launch emissions include targets that would be used to test various BMDS components. The PEIS considered all potential environmental effects including cumulative effects of implementing a proposed BMDS from a programmatic standpoint. The argument that the proposed BMDS would lead other nations to proliferation of weapons of mass destruction is the opinion of the commenter; and as such MDA does not consider it a reasonably foreseeable action to be considered in the PEIS. As shown in Appendix I, foreign military launches were included in the

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		minor but collectively significant actions taking place over a period of time. In the context of this global ballistic missile defense system, the cumulative impact of reasonably-foreseeable future actions of the US as well as other nations, agencies and persons need to be considered. Yet the reasonable foreseeable actions of other nations and individuals responding to the BMDS by proliferating WMD was not considered by the MDA in this PEIS. As stated in Sec. 1508.8 "Effects" include:(a) Direct effects, which are caused by the action and occur at the same time and place and (b) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Effects and impacts as used in these regulations are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial. Thus, by law the MDA also needs to consider the Direct, Indirect and Cumulative impacts on the environment of the proposed BMDS along with other US offensive weapons systems and stated & demonstrated US preemptive first-strike policy.	cumulative impacts analysis to consider impacts on global warming and ozone depletion.

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Cumulative Impacts	PHO0009-1	It's ridiculous that the -- there is 515 launches proposed for Star Wars. That is five times the amount that would be launched under the programs that are non-Star Wars. And you can look this up for yourself. Don't trust me. Check it out. The second thing is the PEIS is based on the Star Wars program as proposed -- and here we have a statement. Okay. This statement was made by General Henry Tray Obering. He's the head of the Missile Defense Agency. So this is not a statement from some conspiracy website. This is a statement from the head of the MDA. What did he say when he was speaking at a Homeland Security conference on a missile defense panel on October 13th in Colorado Springs, Colorado? He was asked about the THAAD, which is the Theater High Altitude Defense Missiles that are scheduled to go into production in 2005. He was asked about these. What did General -- General Henry Tray Obering say about the missiles? He said, quote, These missiles are intended to augment, not replace, the current generation of ground-based midcourse interceptors.	Section 4.1.4 shows that BMDS launches are only three times the number of non-BMDS U.S. launches instead of five times the number as indicated by the commenter. While projected BMDS launches may account for more launches than other U.S. launches, the size of the BMDS boosters would be on average much smaller than those used for other U.S. launches. Boosters were categorized based on the size of the propulsion system. As shown in Exhibit I-2 of Appendix I, all of the 515 projected BMDS launches fall within the low propellant size category. Therefore emissions loads to the stratosphere from BMDS project launches (shown in Exhibit I-6) are less than those for other U.S. launches (shown in Exhibits I-7 and I-8). The number of BMDS project launches outlined in Section 4.1.4 includes all launches related to BMDS operations, including targets and interceptors, and as such does include Terminal High Altitude Area Defense (THAAD) launches. Because the projected launches would include all potential launches and not just GBI launches, the proposed THAAD launches, which are intended to augment the GBI program, would be included in the projected numbers. Therefore, additional launches would not need to be analyzed for the cumulative impacts analysis.
Cumulative Impacts	PHO0023-5	The PEIS is insufficient in dealing with cumulative effects, especially in Southern California, as so many of our local contractors are working on the weapons systems. We're bearing the brunt of our environmental impacts of the laser weapon development and many of the rocket	The PEIS is a programmatic level NEPA analysis that considers implementation alternatives for an integrated BMDS and as such does not address specific sites or specific activities at those sites, but rather considers the program as a whole to allow tiering of subsequent site-

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		launches and the rockets that are being assembled for those launches to launch these 515 launches that may take place over the next 10 years.	specific analyses from the PEIS. Subsequent analyses for activities occurring at specific locations would consider the localized cumulative impacts of those proposed activities at each individual location.
Cumulative Impacts	PHO0044-2	There's some inconsistencies and confusion about cumulative impacts. This EIS estimates 515 launches in a ten-year period, the previous 2003 ground-based missile defense extended test range EIS estimated only 100 in a ten-year period.	The GMD ETR EIS analyzed a total of 100 launches over a 10-year period to validate the GMD ETR test program. The 515 launches analyzed in the PEIS include all launches that would occur as a part of the proposed BMDS including GMD program launches.
Cumulative Impacts	PHO0046-7	The cumulative impacts analysis I think was very flawed. You said earlier that you would only consider similar types of global actions in comparing what the cumulative impacts would be, but I think that's a way of effectively ignoring the combined effects of many, many local impacts that occur when you have these programs in many forms around the world. So I think you need to consider all those analyses, the local studies that are being done, that have been done, past, present and future.	The PEIS is a programmatic level NEPA analysis that considers implementation alternatives for an integrated BMDS and as such does not address specific sites or specific activities at those sites, but rather considers the program as a whole to allow tiering of subsequent site-specific analyses from the PEIS. Subsequent analyses for activities occurring at specific locations would consider the localized cumulative impacts of those proposed activities at each individual location.
Cumulative Impacts	PHO0048-6	Also, the cumulative impact analysis is also inadequate. NEPA requires that past, present, and future activities that may incrementally add up to accumulative impact on an area be assessed, but this PEIS is flawed for several reasons. First, it doesn't really consider past projects in the cumulative impact analysis. It says something to the effect of, well, there are things that had gone through NEPA assessment before and so we're not considering those now. This is obviously logically flawed. I mean, the EISs that we've gone through before, had any of them ever dreamed that there would be a missile defense thing shot from space? I mean, let's look at the Striker IS. We're all familiar with that. Does that mention at all anywhere	The cumulative impact of worldwide launch programs on ozone depletion and global warming does indeed consider the effects of past launch programs as MDA strives to determine impacts on an atmosphere already impacted in these areas by all previous launches. Ozone depletion is well documented as a phenomenon that is caused by complex chemical reactions due to release of chlorofluorocarbons and other industrial chlorine-containing chemicals into the stratosphere as well as other activities like rocket launches that create emissions that may impact ozone depletion. MDA's cumulative analysis takes a snapshot of the affected environment as it currently exists, already affected by years of launches

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		ballistic missiles? No. Okay. So clearly relying on a NEPA document published before this day is not going to give us an adequate analysis of whether it's a cumulative impact. In fact, there's a heck of a lot going on here caused by the military that never went through NEPA analysis.	and other chemical industrial activities in the past. It would be impossible to try to determine the past contribution of launch emissions to ozone depletion and with new regulatory controls the contribution of launch emissions may be increasingly important in the future. Therefore MDA elected to consider the potential contribution from worldwide government and commercial launch programs projecting a launch manifest forward in time from 2004 as an appropriate representation of the cumulative impacts of the BMDS program.
Cumulative Impacts	PHO0048-7	In addition, they also put this really interesting limitation on it that I've never seen before in an EIS, and I've read quite a few myself. It says, well, because this has a national and international nature to the impact of the ballistic missiles, they were only going to consider national/international cumulative impacts. That means only something that affects the entire continent, only if it affects the entire world. So we're not going to look at the unique situation of Hawaii. And what we are having to go through is the increasing militarization of Hawaii, and that's not sufficient. I mean, to really consider the cumulative impacts of this PEIS, we need to talk about things that are in the areas that are likely to be affected and likely to be caused harm.	The PEIS is a programmatic level NEPA analysis that considers implementation alternatives for an integrated BMDS and as such does not address specific sites or specific activities at those sites, but rather considers the program as a whole to allow tiering of subsequent site-specific analyses from the PEIS. As noted in Section 4.1.4 of the PEIS, the proposed BMDS is worldwide in scope. Therefore, it is appropriate to consider other worldwide activities, including U.S. and foreign commercial and foreign government launches, along with the proposed BMDS launches to estimate cumulative impacts.
Cumulative Impacts	PHO0049-1	The cumulative effects on the Marshallese people, for example, who have already been exposed to so much nuclear poison and now you want to add more toxic waste into their lagoons. And the accumulation, the additive factors, I think you have not even touched on how this is	The PEIS is a programmatic level NEPA analysis that considers implementation alternatives for an integrated BMDS and as such does not address specific sites or specific activities at those sites, but rather considers the program as a whole to allow tiering of subsequent site-specific analyses from the PEIS. Cumulative impacts

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		going to impact a group of people that have already suffered enough for us Americans.	from activities occurring in specific locations, such as the Marshall Islands, would be considered in subsequent analyses as appropriate.
Cumulative Impacts	PHW0006-1	1. The 515 projected BMDS launches that are evaluated by the PEIS do not include the intended expansion of the BMDS program, and thus does not meet criteria of the National Environmental Policy Act (NEPA). This intended expansion was described on October 13 by General Henry "Trey" Obering the director of the Missile Defense Agency (MDA). Speaking at the Homeland Security Conference in Colorado Springs General Obering was asked about the new Theater High-Altitude Area Defense (THAAD) missiles scheduled to move into production in late 2005. In response General Obering stated they will "augment, not replace, the current generation of ground-based midcourse interceptors. In fact, there will be a continued spiraling up of capabilities in both missile networks, with more missiles and additional sites being added for the current missiles, and an expansion of THAAD beyond the initial scheduled 25 missiles"	The number of BMDS project launches outlined in Section 4.1.4 includes all launches related to BMDS operations such as targets and interceptors and thus, does include THAAD launches. The projected launches would include all potential launches and not just ground-based midcourse interceptor launches. Therefore, the proposed THAAD launches, which are intended to augment the GBI program, would be included in the projected numbers and additional launches would not need to be analyzed for the cumulative impacts analysis.
Emissions	E0320-1	2. The hydrogen chloride injected into the atmosphere with each launch has incredible potential to neutralize ozone, enlarging the famous hole which now requires Australian school children to be outside only with hats and long-sleeved shirts.	The potential impacts from launches on the atmosphere are discussed in Section 4.1.1.2 of the PEIS. Specifically, the PEIS discusses the fact that atomic and molecular chlorine could be produced as a result of chemical reactions involving hydrogen chloride. Atomic and molecular chlorine have been shown to contribute to localized ozone depletion in the plume wakes of boosters. However, the PEIS found that based on the amount of chlorine produced, the large volume of air volume over which these emissions would be spread, and

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			because of rapid dispersion by stratospheric winds, the active chlorine from launches would not contribute to significant localized ozone depletion. Therefore, it is unlikely that emissions from launches would lead to an increase in skin cancers due to a thinning of the stratospheric ozone layer.
Emissions	E0402-4	1) The result of release of hydrogen chloride, aluminum oxide, and hydrochloric acid into the upper atmosphere will consume huge amounts of ozone, resulting in dramatic increases in UV light exposure with epidemics of skin cancer, cataracts and the less studied but known effects on sensitive species such as amphibians and microscopic organisms.	See previous response.
Emissions	E0424-1	a) The planned heightened increase in missile launches would potentially lead to increased exposures to the population from toxic pollutants. These include liquid propellants containing hydrazines, nitrogen tetroxide, and other toxic compounds. In addition, the ammonium perchlorate used in solid propellants blocks the formation of key thyroid hormones which are critical for the growth and development especially in fetuses and children. The PEIS proposes to allow an over 30-fold higher level of perchlorate (200 parts per billion) than those proposed by the State of California (6 parts per billion). The numerous anticipated rocket launches will release chemicals including aluminum oxide, hydrogen chloride and hydrochloric acid into the upper atmosphere, with the potential for further depleting the diminished ozone layer. For example, each molecule of hydrogen chloride consumes 100,000 molecules of ozone, resulting in the widening of the ozone hole, thereby dramatically	The DoD and the MDA are aware of the potential health concerns associated with perchlorate contaminated water and of the various Federal and state initiatives to address this issue. In addition to citing the Perchlorate Study Group findings, the PEIS has been modified to include the proposed findings from the State of California Office of Environmental Health Hazard Assessment, the State of Massachusetts, and U.S. EPA. To better characterize some of the potential impacts associated with proposed BMDS activities, additional information and research on perchlorate has been added to Section 4.1.1.2 of the Final PEIS. Further, a technical Appendix M addressing issues specifically related to perchlorate has been added to the Final PEIS. The appendix considers the uses, sources, and disposal of perchlorate as well as the effects on human health and the environment.

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		increasing levels of UV light. Elevated levels of UV light cause sunburn, skin cancer, cataracts, and many other forms of UV damage to sensitive species;	The potential impacts from launches on the atmosphere are discussed in Section 4.1.1.2 of the PEIS. Specifically, the PEIS discusses the possibility that ozone would be depleted through complex reactions with chlorine, aluminum oxide, and nitrogen oxides. The PEIS presents a discussion of these complex interactions and supports the determination that "Due to the large air volume over which [chlorine] emissions would be spread, and because of rapid dispersion by stratospheric winds, the active chlorine from launches would not contribute to significant localized ozone depletion.", "The exact magnitude of ozone depletion that can result from a build-up of Aluminum Oxide (Al_2O_3) over time has not yet been determined quantitatively, but appears to be insignificant based on existing analysis.", and "Stratospheric winds would disperse these quantities [of nitrous oxides] rapidly; therefore, no significant effect on ozone depletion would be expected from these emissions. (Molina, 1996 as referenced in U.S. Department of the Air Force, 1997a)
Emissions	E0427-5 and E0439-5	6) Not only does the BMDS PEIS under represent the total amount of emissions, from the estimated 515 BMDS rocket launches over the next several years, it also discounts that this program will be injecting large quantities of chemicals including aluminum oxide, hydrogen chloride and hydrochloric acid into the upper atmosphere, stratosphere, etc. Most concerning is the injection of hydrogen chloride into the upper atmosphere where the breakdown of each hydrogen chloride molecule to chloride ion catalyzed the breakdown of 100,000 ozone molecules, thereby depleting ozone, and decreasing the	See previous response.

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		blocking of UV rays. This depletion of ozone will increase risk of cataracts and skin cancer. Thus, the BMDS will have a much greater effect on ozone depletion and skin cancer than HC1 released at sea level.	
Emissions	E0427-4 and E0439-4	5) The BMDS PEIS did not adequately consider impacts of Hazardous waste and materials and on Health and safety, Water Resources and Biological resources of environmental contamination from toxic and hazardous components of rocket fuels and explosives. The BMDS PEIS markedly under reports the emissions of representative interceptors. Exhibit 4-11 reports the emission of (90+58+52+22+17+6+6)=251 pounds for a representative interceptor. However, ground based interceptors are much larger (approximately 54 feet long 3 stage solid propellant rockets (such as the Minuteman III) weighting 22.5 to 25 tons and containing approximately 30,000 to 45,000 pounds of solid propellant. Thus the MDA underestimates the emissions from such interceptor rockets by factor of greater than 100. This is totally unacceptable. This underestimate of BMDS pollutants is apparently repeated in Exhibits 4-13, 4-14 and 4-15. Thus the MDA needs to revaluate the environmental effects of these pollutants. Also the MDA should define what are the emissions from the missiles used to launch spaced based interceptors, and sensors.	The PEIS did consider the impacts of rocket propellants released into the environment from non-nominal launches or transport/handling spills as hazardous waste, on soils and water resources, on biological resources, and on health and safety. Further the PEIS analyzed the impacts of emissions from nominal launches of various propellant types in support of BMDS test activities. The interceptor emission products noted in Exhibit 4-11 are for a PAC-3 missile. Although all proposed integration test launches would not include the launch of a GBI, the exhibit has been updated to include the emissions from a GBI. As shown in the updated exhibit, even when considering the emissions from a target and a GBI, emissions would not exceed de minimis levels. Further, as noted in Appendix I, various sizes of boosters were considered in calculating the cumulative impact of BMDS launches. Therefore, Exhibits 4-13, 4-14, and 4-15 do not need to be updated. The emissions from the vehicles used to launch the space-based interceptors, sensors and other assets into space have been considered as part of support assets as defined and analyzed in the PEIS.
Emissions	E0429-2	Solid rocket propellant that contains ammonium perchlorate as an oxidizer is designed to generate large quantities of hydrogen chloride, which reacts with moisture in the atmosphere to create hydrochloric acid- that is, acid precipitation. The PEIS should consider how	The BMDS PEIS considers the use of a wide variety of propellants including three types of boosters, pre-fueled liquid propellant, non-pre-fueled liquid propellant, and solid propellant boosters. The environmental impacts of each of these three types of boosters are presented in

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		the missile defense program might develop and test alternate launch technologies that are not so environmentally destructive.	Section 4.1.1.2 of the PEIS. In addition, a technical appendix (Appendix M) has been added to the PEIS that addresses issues specifically related to perchlorate. The appendix includes the alternatives that DoD is currently evaluating to the use of perchlorate in munitions.
Emissions	E0429-7, PHW0004-7, E0429-26, PHW0004-26	3. Evaluate alternative launch technologies not based upon ammonium perchlorate.	See previous response.
Emissions	PHW0004-2	Solid rocket propellant that contains ammonium perchlorate as an oxidizer is designed to generate large quantities of hydrogen chloride, which reacts with moisture in the atmosphere to create hydrochloric acid-that is, acid precipitation. The PEIS should consider how the missile defense program might develop and test alternate launch technologies that are not so environmentally destructive.	See previous response.
Emissions	E0429-3 and PHW0004-3	When rockets are launched into the upper atmosphere, they directly deliver hydrogen chloride to the ozone layer, exposing human, other animals, and other biota to the harmful, persistent effects of ultraviolet-B radiation (UVB). Rocket launches are among the largest causes of ozone depletion, and the persistence of such substances from other sources is no excuse for additional pollution. The BMDS program should at the very least evaluate the mitigation of such seriously harmful environmental consequences through the development and deployment of alternative solid rocket propellants.	The potential impacts from launches on the atmosphere are discussed in Section 4.1.1.2 of the PEIS. Specifically, the PEIS discusses the possibility that ozone would be depleted through complex reactions with chlorine, aluminum oxide, and nitrogen oxides. The PEIS presents a discussion of these complex interactions and supports the determination that "Due to the large air volume over which [chlorine] emissions would be spread, and because of rapid dispersion by stratospheric winds, the active chlorine from launches would not contribute to significant localized ozone depletion.", "The exact magnitude of ozone depletion that can result from a build-up of Al_2O_3 over time has not yet been determined quantitatively, but appears to be insignificant

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			based on existing analysis.", and "Stratospheric winds would disperse these quantities [of nitrous oxides] rapidly; therefore, no significant effect on ozone depletion would be expected from these emissions. (Molina, 1996 as referenced in U.S. Department of the Air Force, 1997a)" The BMDS PEIS considers the use of a wide variety of propellants including three types of boosters, pre-fueled liquid propellant, non-pre-fueled liquid propellant, and solid propellant boosters. The environmental impacts of each of these three types of boosters are presented in Section 4.1.1.2 of the PEIS. In addition, Appendix M includes DoD-wide research initiatives under the Strategic Environmental Research and Development Program that have focused on the development of more environmentally-friendly launch technologies, such as missile propellants that do not use ammonium perchlorate as an oxidizer. While these alternate propellant formulations have showed promise, a significant amount of development remains to optimize the formulation for specific missile systems. In addition, these formulations will go through a lengthy and stringent performance and safety certification process. Since these alternative technologies are in a research and development phase and are not yet advanced enough for their use to be reasonably foreseeable under NEPA, they are not analyzed in this PEIS. The MDA may consider the use of these alternative environmentally-friendly technologies as they become available in the future and meet the operational test requirements for the BMDS.

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			Among launch technologies that are available today, the BMDS PEIS considers a wide variety of propellants used in three types of boosters, pre-fueled liquid propellant, non-pre-fueled liquid propellant, and solid propellant boosters. The environmental impacts of each of these three types of boosters are presented in Section 4.1.1.2 of the PEIS.
Emissions	PHO0011-1	As we know, the -- the perchlorates are used in the self-propellants in the formation of a key thyroid hormone which are critical for growth and development of fetuses and children. The PEIS proposes to allow over thirty-fold higher levels of perchlorate at 200 parts per billion than proposed by the State of California, which is six parts per billion. Thus, many rocket launches will inject chemicals including aluminum oxide, hydrogen chloride and hydrochloric acid directly into the upper atmosphere, thereby depleting the ozone. The PEIS does not address the direct injection of the chemicals high into the atmosphere.	The DoD and the MDA are aware of the potential health concerns associated with perchlorate contaminated water and of the various Federal and state initiatives to address this issue. In addition to citing the Perchlorate Study Group findings, the PEIS has been modified to include the proposed findings from the State of California Office of Environmental Health Hazard Assessment, the State of Massachusetts, and U.S. EPA. To better characterize some of the potential impacts associated with proposed BMDS activities, additional information and research on perchlorate has been added to Section 4.1.1.2 of the Final PEIS. Further, a technical Appendix M addressing issues specifically related to perchlorate has been added to the Final PEIS. The appendix considers the uses, sources, and disposal of perchlorate as well as the effects on human health and the environment. The potential impacts from launches on the atmosphere are discussed in Section 4.1.1.2 of the PEIS. Specifically, the PEIS discusses the possibility that ozone would be depleted through complex reactions with chlorine, aluminum oxide, and nitrogen oxides. The PEIS presents a discussion of these complex interactions and supports the determination that "Due to the large air

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			volume over which [chlorine] emissions would be spread, and because of rapid dispersion by stratospheric winds, the active chlorine from launches would not contribute to significant localized ozone depletion.", "The exact magnitude of ozone depletion that can result from a build-up of Al_2O_3 over time has not yet been determined quantitatively, but appears to be insignificant based on existing analysis.", and "Stratospheric winds would disperse these quantities [of nitrous oxides] rapidly; therefore, no significant effect on ozone depletion would be expected from these emissions. (Molina, 1996 as referenced in U.S. Department of the Air Force, 1997a)
Emissions	PHO0025-2	Further, rocket launches deliver hydrochloric acid in the upper atmosphere which, in turn, chemically interact with the protective ozone layer. It is therefore fair to assume that an increase in rocket launches may correspondingly bring about additional cases of skin cancer.	The potential impacts from launches on the atmosphere are discussed in Section 4.1.1.2 of the PEIS. Specifically, the PEIS discusses the fact that atomic and molecular chlorine could be produced as a result of chemical reactions involving hydrogen chloride produced from SRMs. Atomic and molecular chlorine have been shown to contribute to localized ozone depletion in the wake of SRM boosters. However, the PEIS found that based on the amount of chlorine produced, the large volume of air volume over which these emissions would be spread, and because of rapid dispersion by stratospheric winds, the active chlorine from SRM launches would not contribute to significant localized ozone depletion. Therefore, it is unlikely that emissions from MDA test launches would lead to an increase in skin cancers due to a thinning of the stratospheric ozone layer.

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Emissions	E0162-11	9)There are egregious errors in Exhibit 4-11 on page 4-102. There is an addition error in the line for HC1 emissions. The more serious error is that the total emissions of 115 kilograms for the representative interceptor is too small by a factor exceeding 100. Table 4.1.1-8 of the 2003 GMD ETR Final EIS gives total stage 1 exhaust emissions of greater than 15,000 kilograms. The GBI analyzed in that EIS had a total propellant mass of 19,767 kilograms of which 15,069 was in stage 1. The PEIS notes on page D-20 that each GBI may contain up to 20,500 kilograms of solid propellant. Exhibit 4-11 should be corrected; the information for BMDS launches in Exhibits 4-13, 4-14, and 4-15 may need correction if it is based on the interceptor data in Exhibit 4-11.	Addition error has been addressed. The interceptor emission products noted in Exhibit 4-11 of the Draft PEIS are for a PAC-3 missile. Although all proposed integration test launches would not include the launch of a GBI, the exhibit has been updated to include the emissions from a GBI. As shown in the updated exhibit, even when considering the emissions from a target and a GBI, emissions would not exceed de minimis levels. Further, as noted in Appendix I, various sizes of boosters were considered in calculating the cumulative impact of BMDS launches. Therefore, Exhibits 4-13, 4-14, and 4-15 do not need to be updated.
Emissions	PHO0044-3	There's an egregious error in Exhibit 4-11 on page 4-102. First of all, there's an addition error in the table. The more serious error is that total emissions for the interceptor are given as 115 kilograms, whereas the 2003 EIS for the ground-based interceptor gave the first stage emissions as 15,000 kilograms. So what's given in this EIS is a factor of 100 too small.	See previous response.
Emissions	E0427-5 and E0439-5	6) Not only does the BMDS PEIS under represent the total amount of emissions, from the estimated 515 BMDS rocket launches over the next several years, it also discounts that this program will be injecting large quantities of chemicals including aluminum oxide, hydrogen chloride and hydrochloric acid into the upper atmosphere, stratosphere, etc. Most concerning is the injection of hydrogen chloride into the upper atmosphere	The potential impacts from launches on the atmosphere are discussed in Section 4.1.1.2 of the PEIS. Specifically, the PEIS discusses the fact that atomic and molecular chlorine could be produced as a result of chemical reactions involving hydrogen chloride. Atomic and molecular chlorine have been shown to contribute to localized ozone depletion in the wake of boosters. However, the PEIS found that based on the amount of

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		where the breakdown of each hydrogen chloride molecule to chloride ion catalyzed the breakdown of 100,000 ozone molecules, thereby depleting ozone, and decreasing the blocking of UV rays. This depletion of ozone will increase risk of cataracts and skin cancer. Thus, the BMDS will have a much greater effect on ozone depletion and skin cancer than HC1 released at sea level.	chlorine produced, the large volume of air volume over which these emissions would be spread, and because of rapid dispersion by stratospheric winds, the active chlorine from launches would not contribute to significant localized ozone depletion. In addition, the PEIS considers the possibility that ozone would be depleted through complex reactions with chlorine, aluminum oxide, and nitrogen oxides. The PEIS presents a discussion of these complex interactions and supports the determination that "Due to the large air volume over which [chlorine] emissions would be spread, and because of rapid dispersion by stratospheric winds, the active chlorine from launches would not contribute to significant localized ozone depletion." "The exact magnitude of ozone depletion that can result from a build-up of Al_2O_3 over time has not yet been determined quantitatively, but appears to be insignificant based on existing analysis.", and "Stratospheric winds would disperse these quantities [of nitrous oxides] rapidly; therefore, no significant effect on ozone depletion would be expected from these emissions. (Molina, 1996 as referenced in U.S. Department of the Air Force, 1997a)" Therefore, it is unlikely that emissions from launches would lead to an increase in skin cancers due to a thinning of the stratospheric ozone layer.
Environmental Justice	E0363-2	Certainly, those individuals (often consisting of minority ethnic groups) and non-human species who live on or near test sites are at particular risk, and this issue is not sufficiently addressed in the PEIS.	The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws,

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			regulations, and policies is defined as environmental justice. Environmental justice is discussed in Section 3.1.5 of the PEIS. This programmatic analysis does not consider impacts at specific locations or sites; therefore, it is not possible to perform a meaningful environmental justice analysis as directed by Executive Order (EO) 12898; however, a roadmap for subsequent tiered analyses is included in Section 3.1.5. As specific locations are identified for possible BMDS activities tiered site-specific analyses would consider environmental justice.
Environmental Justice	PHO0025-5	There should also be an environmental health evaluation concerning cumulative impacts for military production, testing and deployment of missile defense systems compounded on top of past military use. This evaluation should be done with an eye on disproportionate impacts on low-income communities of color.	See previous response.
Environmental Justice	PHO0046-8	And this gets to the environment justice analysis, which is also flawed and inadequate. There is an adverse and significant impact on native peoples here in Hawaii, in Greenland, Enewetak in the Marshall Islands, and in other places, Alaska and so forth, and you did not look at how this program has a disparate effect on those peoples, their culture, their resources, and actually their survival. So please consider those.	See previous response.
Environmental Justice	PHO0051-7	Also, Ohana Koa believes that Star Wars will have a significant adverse impact on native Hawaiians, our Marshall Island brothers and sisters, the Enewetaks, and other indigenous peoples; and that the Programmatic	See previous response.

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		Environmental Impact Statement fails to consider these impacts.	
Environmental Justice	M0268-4	Effect of hazardous and toxic waste on minority communities: As an organization we have a strong concern for human rights and racial justice. We note that the Environmental Impact Assessment requires consideration of undue negative impact on minority communities. It is our understanding that the test sites are mainly on Indian lands or on lands belonging to Marshall Islanders. The statement in the PEIS that "Environmental justice analyses require information about local communities, and therefore will be analyzed in site specific environmental documentation. " is hardly adequate. We know what damage has been done to such communities already by bombing ranges (as in Puerto Rico) or nuclear weapons testing (as in the South Pacific and on Indian lands in the U.S. southwest). Such an analysis should have been made before the deployment and testing began. The program should be halted until thorough analysis is made, and it should not continue if there is evidence of detrimental effect on these populations and their environment.	See previous response.
Hazardous Materials Hazardous Waste	E0395-13	The PEIS does not present the total quantities of specific hazardous chemicals that would be carried aboard an ABL aircraft nor does it describe the total quantities of specific hazardous chemicals that would be stored on the ground at various test and training locations. In addition, the PEIS does not address the environmental impacts should those chemicals be spread over the land from an accident or aircraft crash, or jettisoned at low altitude in an emergency.	The PEIS is a programmatic analysis and is intended to serve as a tiering document for future site-specific analyses. Therefore, it is not possible to consider the total quantities of specific hazardous materials that would be used at a specific facility. Future tiered analyses would need to consider the impacts associated with the quantities of hazardous materials used and hazardous waste generated as a result of a particular action or test. The PEIS presents information on the

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			potential environmental impacts of possible failure scenarios for various components including laser weapons operating from air environments. In addition, the amounts of chemicals used in the ABL are provided in the EIS for the Program Definition and Risk Reduction Phase of the Airborne Laser Program (U.S. Department of the Air Force, 1997b) and Airborne Laser Program Supplemental EIS (MDA, 2003a), which are incorporated by reference (as listed in Appendix C).
Hazardous Materials Hazardous Waste	E0429-22	The PEIS should consider the environmental consequences of various disposal strategies so the BMDS program can develop the technology or capacity to address its waste or consider the use of alternative launch technologies or strategies to minimize either the waste or the negative environmental impacts.	The BMDS PEIS considers the use of a wide variety of propellants including three types of boosters, pre-fueled liquid propellant, non-pre-fueled liquid propellant, and solid propellant boosters. The environmental impacts of the use of each of these three types of boosters are presented in Section 4.1.1.2 of the PEIS. The BMDS must rely on the most appropriate launch technology to support the development, testing, deployment, and decommissioning of an integrated missile defense capability. Many of the boosters used as target missiles for the BMDS would already have been manufactured for other DoD programs, which are in inventory and no longer needed. The MDA will continue to use appropriate disposal strategies to handle hazardous materials and waste. The environmental impacts of hazardous materials and hazardous waste generated from launch related activities are considered in Section 4.1.1.2 of the PEIS.
Hazardous Materials Hazardous	PHW0004-22	The PEIS should consider the environmental consequences of various disposal strategies so the BMDS program can develop the technology or capacity to address	See previous response.

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Waste		its waste or consider the use of alternative launch technologies or strategies to minimize either the waste or the negative environmental impacts.	
Hazardous Materials Hazardous Waste	F0006-1	1. NOAA Fisheries recommends that the Missile Defense Agency be responsible for handling and disposing of all hazardous materials or hazardous wastes in all phases of the proposed action in accordance with applicable Federal, state, and local laws, utilizing best management practices at all life cycle activities of the proposed action and through appropriate project planning and design measures including appropriate spill prevention, control and contingency plans (e.g., Oil Discharge Prevention and Contingency Plan, Storm Water Pollution Prevention Plan) for each site.	The disposal of all hazardous materials and hazardous wastes would be conducted in compliance with applicable Federal, state, and local laws. Project planning would take spill prevention, control, and contingency planning into account to ensure compliance with all relevant regulations.
Health and Safety	E0319-10	The BMDS Draft PEIS discusses ground testing of 'portable' lasers, but does not list all the potential test sites. A September 2004 ABC news report stated a Delta Airlines pilot received an eye injury when a laser beam came through the cockpit window on his approach to the Salt Lake City, Utah airport. There have been no further reports regarding where the laser beam originated; however, it leaves open the possibility of whether some ground-based or air-based laser tests were going on at the High Energy Laser Systems Test Facility located at the White Sands Missile Range in New Mexico and the Delta Airlines pilot happened to get caught in the laser's crossfire. Utah and New Mexico are within close proximity in air miles. As stated in the Draft PEIS (Volume 1, page 4-21 thru 4-34), environmental and human health hazards would result from testing air based and ground based 'portable' lasers, which is: cancer	As referenced in the comment, the PEIS discusses the potential impacts on health and safety and biological resources from the activation and use of laser weapons (Section 4.1.1.1) and laser sensors (Section 4.1.1.5). If it is determined that laser weapons or laser sensors need to be tested at specific locations, the environmental impacts of their use at these locations would be considered in subsequent site-specific NEPA analyses tiered from this PEIS, as appropriate.

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		causing chemical releases into the air and waters, potential skin burns and retina damage from laser beams and/or laser 'scatter', hazards to commercial and other aircraft, birds, plants and wildlife. "Hydrochloric acid produced as a result of the interaction between laser emissions and moisture in the air has the potential to produce impacts on biological resources, including plants and aquatic animals, and water quality" (Draft PEIS Volume 1, page 4-23). "Exhaust emissions from laser activation have the potential to harm human health." "Laser beams can cause serious health problems if they contact the skin or eyes" (Volume 1, page 4-34).	
Health and Safety	E0319-18	The safety hazards of launching interceptors from the KLC should have been discussed in the Draft PEIS, considering the high winds which occur on Kodiak Island throughout the year-- peak gusts up to 35 miles per hour in June and 83 miles per hour in December (PEIS Volume 2, Page H-18, Section H.2.1-Air Quality). As Kodiak residents have previously pointed out to the MDA in other EA comments (which the MDA has ignored), launching missile targets, and now possibly interceptors in a southwest trajectory down the East side of Kodiak Island would be extremely risky and potentially hazardous should a launch accident occur, because of populated native villages (e.g. Old Harbor and Akhiok) which are within the 'explosive safety hazard zone'.	The GMD ETR EIS did analyze the environmental impacts of launching interceptors from KLC. However, the MDA announced in a ROD that there were currently no plans to launch interceptors from KLC. This is still the case. The environmental impacts of conducting launch activities from the KLC have been considered in a number of earlier NEPA analyses. Site-specific environmental analyses tiered from this PEIS will be conducted for future proposed activities at specific sites such as the KLC, as appropriate.
Health and Safety	E0319-23	Executive Order 13229 (October 9, 2001) does not change the requirements of EO 13045 (April 21, 1997), it only amends section 3-306 of that order "for a period of 4 years from the first meeting" and inserting in lieu thereof "for 6 years from the date of this order". The PEIS cannot	In considering the potential impacts to health and safety from the BMDS as described in Section 4 of the BMDS PEIS, the MDA did not identify any environmental health and safety risks that may disproportionately affect children.

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		identify environmental health and safety risks if the Department of Defense (MDA) has not requested any studies on the issue.	
Health and Safety	E0319-25	Executive Order 13045, Section 1. Policy 1-101 states: "A growing body of scientific knowledge demonstrates that children may suffer disproportionately from environmental health risks and safety risks. These risks arise because: children's neurological, immunological, digestive, and other bodily systems are still developing; children eat more food, drink more fluids, and breathe more air in proportion to their body weight than adults". Section 2-203, "Environmental health risks and safety risks means risks to health or safety that are attributable to products or substances that the child is likely to come into contact with or ingest (such as the air we breathe, the food we eat, the water we drink or use for recreation, the soil we live on, and the products we use or are exposed to)". Once again, refer to Draft PEIS Volume 2, pages H-18, H-19-Existing Emission Sources; "Most sites where activities for the proposed BMDS may occur would be classified as a major emissions source". It is the major emission sources related to MDA activities, which has the people living near launch test sites concerned. The PEIS should include ALL test sites locations that will be affected by future BMDS activity.	The MDA complies with all applicable regulations to address disproportionate risks to children that result from environmental health risks or safety risks. The MDA strives to protect human health (including that of our children) and the environment while carrying out its mission. The definition used for "major source" in the PEIS is the same that is used in the Clean Air Act Section 112(a)(1). This section defines "major source" as "any stationary source or group of stationary sources located within a contiguous area and under common control that emits or has the potential to emit considering controls, in the aggregate, 10 tons per year or more of any hazardous air pollutant (HAP) or 25 tons per year or more of any combination of HAPs. The Administrator may establish a lesser quantity, or in the case of radionuclides different criteria, for a major source than that specified in the previous sentence, on the basis of the potency of the air pollutant, persistence, potential for bioaccumulation, other characteristics of the air pollutant, or other relevant factors." Site-specific environmental analyses will be conducted for future proposed activities at specific locations, as appropriate.
Health and Safety	E0380-1	1) In category after category, case after case, the PEIS repeatedly discounts the impacts of toxic substances resulting from and involved in activities at every level - manufacture, launching, use, etc. - by contending that the toxic substances will have no impact because they will be handled in accordance with existing law and guidelines.	As stated in the PEIS, the MDA would comply with all applicable regulations and requirements regarding the use and disposal of toxic substances. In addition, activities proposed at specific ranges/facilities will comply with applicable mitigation measures that apply to

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		Such a blanket contention flies in the face of current experience with toxic substances. Many factors result in the legal guidelines failing to insure public and environmental safety when toxic substances are involved. The report fails to entertain the possibility of accidental spills and discharges, whether in the transportation stage or as a consequence of mishaps at other stages. Additionally, the report ignore our experiences in which we have repeatedly experienced toxic consequences from currently legal uses of chemicals. The claim that there will be no toxic impacts by merely following existing handling rules is implausible. Moreover, new discoveries about the minute amounts of substances that can still have a deleterious effect are continually forcing us to readjust safety standards. To initiate the massive undertakings proposed within the BMDS without making any attempt to mitigate the impacts - readily imaginable based on the evolving nature of toxin safety understandings - is unrealistic.	the specific range/facility where the actions are proposed to occur. The potential impacts associated with the accidental release of toxic substances including laser chemicals and booster propellants are discussed in Sections 4.1.1.1 and 4.1.1.2 of the PEIS.
Health and Safety	E0425-1	Please factor an inhalation pathway for exposure to ammonium perchlorate. Please assess for both public and occupational exposure. For toxicity information on this newly discovered pathway please see the following study.	The acute toxic effects found in the referenced study occurred when high levels of ammonium perchlorate were injected into rats' lungs. Available research suggests that the possibility of ammonium perchlorate inhalation is small because there is little or no residual perchlorate left after combustion of the solid propellant. This research would suggest that any exposure to ammonium perchlorate through air would not be at a high enough level to cause these kinds of effects.

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			The MDA has reviewed available research on perchlorate and developed an appendix (see Appendix M) to the PEIS which provides additional information on the potential human health impacts of perchlorate.
Health and Safety	E0427-11 and E0439-11	The BMDS PEIS (page 4-32) cites that exposure to a reflected laser beam while in the air operating environment would be very short, < 0.01 seconds that and would not impact the health and safety (US Air Force 1997A). But no estimates are provided for the actual danger zone for the HEL to detrimentally affect health and safety, e.g. causing skin and especially retinal damage. The Draft Supplemental Environmental Impact Statement for the Airborne Laser Program (2002) (page 99) cites the power of the HEL as about 107 watts per square centimeter. Ten million watts per square centimeter will burn retinas and eyeballs very quickly. While the PEIS states that medium energy lasers such as the SHEL if focused at point 12 km away, would be hazardous to the human eye 2 km before to 2 km past the focus point. Where as the other lasers and especially the HEL would be hazardous immediately after leaving the turret of the ABL. While the PEIS states that the BILL and TILL no hazard distance would extend > 10 km beyond the target, and the HEL hazard distance would extend even beyond these distances. But the BILL, TILL and I presume the HEL hazard distances are apparently classified. How can the public comment on the effects of the BILL TILL and especially the HEL on health and safety if the distance at which these lasers cause eye damage is not available? The public and the MDA / Air force need to make this	As referenced in the comment, the PEIS discusses the potential impacts on health and safety and biological resources from the activation and use of laser weapons (Section 4.1.1.1) and laser sensors (Section 4.1.1.5). If it is determined that laser weapons or laser sensors need to be tested at specific locations, the environmental impacts of their use at these locations would be considered in subsequent site-specific NEPA analyses tiered from this PEIS, as appropriate.

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		information available to better ensure the heath and safety of the public.	
Health and Safety	E0427-12 and E0439-12	The PEIS focuses on the testing of these lasers, but fails to reveal whether once deployed, the ABL or any other BMDS weapons lasers will ever be directed toward aircraft including airliners, or individuals on the surface of the earth, e.g. on land or at sea. If so, the MDA needs to address the effects of HEL and other weapons lasers on endangering health and safety, especially skin and eye damage.	The ABL is designed to intercept threat missiles in the boost phase of flight. The ABL would be deployed to and operate in areas where boost-phase intercepts could be attempted. Its effectiveness is undergoing thorough testing as an integral component of the BMDS boost phase defense. The MDA has no plans to use the ABL for terrestrial targets.
Land Use	M0275-4	Page 3-31: In the portion titled "Impact assessment," we suggest referencing the Service National Wildlife Refuges.	A reference to the Service National Wildlife Refuges has been added to the BMDS.
Orbital Debris	F0005-14	Nor would the back-of-the-envelope dismissal of debris, orbital and otherwise. Frequently the PEIS posits that such debris poses a small risk, and downgrades the threat - which would come as a great surprise to our partners in the International Space Station. LAWS adopts and incorporates here by reference the compelling exposition of the dangers from space debris set out in the October 18, 2004 testimony of Theresa Hitchens, Vice President and Director of Space Security of the Center for Defense Information. This is a dramatically fatal flaw in the PEIS; one that ought not be swept under the NEPA rug.	Specific altitudes at which high altitude ground-based intercepts would take place are not provided in the BMDS PEIS. MDA has not underestimated the risk to spacecraft and the space environment. For every flight test, a detailed and comprehensive assessment of the risks posed to spacecraft is conducted. The risk assessment calculates the probability of impact between intercept debris and spacecraft as a function of time in a launch window. These calculations are not "back of the envelope" approximations of the risk; rather they account for both spatial and temporal changes in intercept debris flux, satellite area, satellite dwell time within the cloud, and so forth. The analysis allows mission planners and test conducters to determine the safest time to conduct a flight test minimizing the risk to both manned and unmanned spacecraft.

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			Analysis shows that most of the intercept debris (>90%) reenters within six hours of the intercept. The remaining debris spreads into the background of space where it becomes indistinguishable from the background debris that has accumulated over decades of space operations. In fact, background debris poses a far greater risk to the International Space Station (ISS) than intercept debris. Testing of space-based interceptors would only be conducted in areas where airspace had been cleared. For debris reentering in an uncontrolled manger, most debris would not be expected to survive the severe heating and other forces during reentry. During the past 40 years an average of one cataloged piece of debris fell back to Earth each day and no serious injuries or significant property damage has been confirmed. As stated in Section 4.2.1, during testing the MDA would design flight test scenarios so that interceptor and target debris impacts in designated areas within the ocean or on cleared land-based ranges. Because the development of a space-based test bed is too speculative to be analyzed in this PEIS, the specific impacts of launching interceptors from space-based platforms for BMDS testing would be considered in subsequent analyses as appropriate. The MDA wanted to consider the broad possibilities of space-based interceptors as an alternative strategy to enhance the integrated BMDS recognizing that the technologies for this application are in initial stages of planning and development and that

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			subsequent NEPA analyses would likely be needed as technologies and plans became more mature. The MDA has created a technical appendix to the PEIS (see Appendix L), which provides additional information on the creation, reentry, and disposition of orbital debris.
Orbital Debris	PHO0002-3	Major inadequacies in the PEIS treatment of issues related to debris include: Number one: the PEIS severely understates the potential threats to satellites and spacecraft, as well as to people and objects on the ground, from orbital debris caused by ground-based midcourse interceptor tests.	See previous response.
Orbital Debris	PHO0002-4	The PEIS fails to support its claim that little debris would be created because of lack of adequate modeling of likely debris creation from realistic testing of the ground-based interceptor, which would involve higher speed impacts at higher altitudes than testing so far. Under realistic testing of GBIs, ground-based interceptors, there is a significant chance that debris could be created that would last for years, not simply the months as asserted by the PEIS.	See previous response. Also note hypervelocity intercepts create debris. As stated earlier, most of the debris reenters within a few hours of the intercept. Detailed analysis of the risks posed to spacecraft is conducted as part of the mission planning process.
Orbital Debris	PHO0023-6	Last but not least, I would also suggest that you conduct a space debris analysis, as you have sited in the PEIS, that there may be intercepts as high a 400 kilometers. That either you do testing at 400 kilometers, which is ill-advised because of the debris problem, but how would you know if the weapons work unless you conduct the tests? Or you should actually assume that the weapons won't work because you cannot conduct the tests at 400 kilometers above.	See previous response.

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Orbital Debris	PHO0037-3	Third, it neglected to look at space debris from high altitude midcourse missile intercepts or destruction of satellites, and it really glossed over potential impacts of debris falling to earth. It just wrote them off as being burned up in the atmosphere.	See previous response.
Orbital Debris	PHW0003-2	Ground-based interceptors will create debris in LEO if they impact their targets (Intercontinental Ballistic Missiles [ICBMs] fired at the United States) in the so-called mid-course phase, when they are outside the Earth's atmosphere. In this phase, the ICBM will be either rising into LEO, at the peak of its trajectory, or starting to descend back through space into the atmosphere. The PEIS states, "The amount of orbital debris could increase from .. .Ground-based Midcourse Defense ... . Such increases in orbital debris would be temporary, as studies indicate that objects in orbit between 200 and 399 kilometers (123 to 248 miles) reenter the atmosphere within a few months." This statement, however, is somewhat misleading. Up to now, MDA has been configuring ground-based, mid-course intercept tests so as to avoid debris creation, conducting tests at low altitudes and slow speeds, with both interceptor and target on a downward trajectory, so debris created will rapidly reenter the atmosphere.	See previous response.
Orbital Debris	PHW0003-7	Second, even if "best guesses" about a SBI configuration are used based on previously proposed and internal MDA designs, the PEIS fails to take into account the issues mentioned above regarding altitude, size and persistence of debris created by midcourse intercepts, and likely dangers to spacecraft from it.	See previous response.

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Orbital Debris	PHW0001-6	As Ms. Hitchins makes clear, the PEIS fails to adequately analyze and discuss the possible dangers of debris in space. If the missile defense program has an Achilles heel, this is it. It is inexcusable for the MDA not to have undertaken or provided adequate scientific review of the physics involved in debris creation and re-entry, as well as of the multiple scenarios for missile defense intercepts. The dangers to people, and to objects in the air and on the ground are real, yet the PEIS blithely ignores such dangers. Depending upon the missile trajectory, debris could also be a threat to Canadian citizens, aircraft and ground facilities. As Ms. Hitchens notes, all T trajectories to the continental US from North Korea pass over both Canada and Russia, so that both nations are potentially at risk from boost-phase shortfall.	As noted in Section 4.1.1.2 of this PEIS, trajectory modeling would be conducted to verify that launch-related debris would be contained within predetermined areas, all of which would be located away from land and populated areas. The MDA has created a technical appendix to the PEIS (see Appendix L), which provides additional information on the creation and reentry of orbital debris.
Orbital Debris	PHW0002-4	Nowhere is this dismissive attitude indicated more clearly than in how the draft PEIS treats debris, orbital and otherwise. Orbital debris is listed as a resource consideration "because of the likelihood of orbital debris occurring from various launch and testing activities and its potential for impact to health and safety and the environment." (p. ES-12) Yet in every case that orbital debris is detailed as resulting from the proposed actions, it is written off as a non-threat to space assets or the terrestrial environment. It is claimed that the orbital debris from booster failure, for example, would be on-orbit for too little time to create damage, and that it would burn up upon re-entry, but even if it didn't, the likelihood of damage is small, (p. ES-21) This same justification is repeated ad nauseum throughout the document. The draft PEIS does admit that the International Space Station (ISS)	Analysis shows that most intercept debris reenters (>90%) within six hours of the intercept. The remaining debris spreads into the background of space and becomes a part of the background debris field. NASA estimates that there are several hundred million particles of background debris (> 1mm). Intercept debris adds a very small fraction (< 1%) to the overall background debris. Hence the overall background debris count and the resulting risk do not change appreciably. Many orbiting structures can practice collision avoidance, or alterations of their orbit, to avoid cataloged debris. Please note that the U.S. Air Force's Space Control Center indicated that the ISS has practiced collision avoidance six times; however, similar maneuvers are conducted on an approximately monthly

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		may be affected by orbital debris, but again downgrades the threat, saying that the ISS could merely do collision avoidance to ensure its safety, (p. ES-39) This no doubt comes as surprise to our partners in the ISS who were unaware that we were planning on weapons systems that very well could destroy our joint effort unless valuable fuel was used to effect a collision avoidance strategy. This dismissal of the threat of orbital debris to space assets contradicts statements made elsewhere in the draft PEIS. The document discloses that "little advance warning could be given to clear air space" if an SBI had an uncontrolled reentry, (p. 4-121) And, with a nod to the unpredictable, the document says, "Objects reentering may skip off the Earth's atmosphere, similar to a stone skipping across a pond, causing them to impact much farther away than originally predicted." (p. 4-122) Despite this, the document still clings stubbornly to the conclusion that orbital debris would have no significant impact.	basis to maintain orbital altitude. The MDA, however, would conduct pre-flight launch window screening to ensure that high altitude tests would only be conducted when ISS would not pass through the resulting debris clouds. Testing of space-based interceptors would only be conducted in areas where airspace had been cleared. For debris reentering in an uncontrolled manner, most debris would not be expected to survive the severe heating and other forces during reentry. During the past 40 years an average of one cataloged piece of debris fell back to Earth each day and no serious injuries or significant property damage has been confirmed. The MDA has added an appendix to the PEIS (Appendix L), which provides additional information on the creation, reentry, and disposition of orbital debris.
Orbital Debris	PHO0002-1	The overall assumption of the PEIS is that there is a low-level risk from either orbital debris or debris reentering the Earth's atmosphere, and that is not supportable, due in large part to the failure of the MDA to undertake and provide adequate scientific review of the physics involved in debris creation and reentry from the multiple possible scenarios for missile defense intercepts.	MDA has conducted an exhaustive study on this subject. Results are being coordinated with the space community. Testing would be conducted such that intercept debris would fall into the open ocean or over restricted land areas. MDA has conducted modeling of high altitude ground-based intercepts. This modeling has shown that the majority of post-intercept debris resulting from high altitude intercepts would reenter the atmosphere within a few hours. A small amount of post-intercept debris may become orbital debris; however, risks to spacecraft from this debris are less than the risk posed by existing background debris. The MDA has created a technical

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			appendix to the PEIS (see Appendix L), which provides additional information on the creation and reentry of orbital debris.
Orbital Debris	PHW0003-1	The PEIS, however, dramatically fails to address the potential dangers (both to space-based objects and those on the Earth) from space debris that MDA admits will be created by testing or use of ballistic missile interceptors. The PEIS states (p. ES-33): "Proposed BMDS space-based sensor activities would be expected to produce small quantities of debris, primarily explosive bolts and small pieces of hardware. It may be possible for debris from an exoatmospheric intercept to become orbital debris. However, because the majority of the BMDS activities would occur in Low Earth Orbit where debris would gradually drop into successively lower orbits and eventually reenter the atmosphere, the debris would not be a permanent hazard to orbiting spacecraft. As BMDS testing becomes more realistic, there is a potential for an increased amount of debris reaching and remaining on orbit. A large portion of this debris would likely not remain on orbit for more than one revolution, and eventually all of the debris would be expected to de-orbit." While these statements are perhaps true, they also serve to downplay the possible dangers of debris. The overall assumption in the PEIS that there is a low-level of risk is not supportable, due to the failure of MDA to undertake or provide adequate scientific review of the physics involved in debris creation and reentry, as well as of the multiple scenarios for missile defense intercepts. The following is	See previous response.

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		an overview of the major inadequacies in the PEIS treatment of issues related to orbital debris.	
Orbital Debris	PHO0002-6	Finally, the PEIS asserts that most of the debris created in low Earth orbit would be small and thus not a major hazard to the ISS. Unfortunately, as I said, even tiny pieces of debris could destroy the ISS or other space assets. In actuality, small debris is considered by space operators as a bigger hazard to space objects because it cannot be detected and tracked adequately enough to allow planning for evasive maneuvers by those space objects that can do so. In other words, smaller debris could be a bigger threat to the ISS and other craft than larger pieces on orbit, and the PEIS undertakes no review of this fact of physics.	See previous response.
Orbital Debris	PHW0003-3	In the last successful test in October 2002, the interceptor hit the target at an altitude in excess of 210 kilometers (140 miles) above the Earth, at a speed of about half of what would be required in a real-life scenario. Realistic testing and employment of a ground-based mid-course system would require intercepts at higher altitudes orbit of around 300+ kilometers and extremely high speeds, and would more likely take place with both the interceptor and the target flying in an upward trajectory - facts of physics that would lead to the creation of more debris and likely result in debris being flung into a higher orbital plane than the altitude of the intercept itself. If the debris ends up orbiting at higher than 399 kilometers, it could remain in space for years. There is no evidence that the PEIS takes into account this latter possibility.	Higher intercept altitudes with both the interceptor and target on ascending trajectories do not create more debris, as the author indicates. The amount of debris produced is proportional to the closing velocity and the mass properties of each object (density, mass distribution) not the intercept conditions. MDA conducts a rigorous analysis to assess the risk to both manned and unmanned spacecraft prior to each mission. This analysis determines the safest time to conduct the flight test minimizing the probability of impact between intercept debris and spacecraft (including the ISS). The relatively small percentage of intercept debris (<10%) that remains orbital does not retain any semblance to a "cloud". It is important to understand that as a result of the high spreading velocities imparted to the debris post-intercept, the intercept debris spreads

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		Even if the debris remains in space only for a "few months" it would still pose a potential threat to space assets in its orbital pathway, including perhaps, as the PEIS itself admits, the International Space Station (ISS). While, as the PEIS notes, the ISS can be (and has been in the past) moved to avoid potential collision with space debris, this is not a simple task and takes time. Indeed, the PEIS couches its language on threats to the ISS by saying only that it "may be possible" for the ISS to perform collision avoidance to get out the way of any "large debris" created. Further, many other satellites in LEO lack the ability to maneuver at all to avoid debris - a fact that the PEIS fails to mention.	into the background, becomes a part of the background debris field - indistinguishable from background debris. With respect to the ISS, collision avoidance maneuvers would not be necessary. As per the current coordination with Air Force Space Command, safe launch times would be selected so that the debris cloud avoids the ISS altogether.
Orbital Debris	PHO0002-2	Space debris is a major hazard to spacecraft and satellites because of the high impact velocities generated in orbit, meaning that even tiny pieces of debris, which you mention, such as bolts can damage or destroy an on-orbit asset. Reentry of space-based objects, such as the SBIs, can also threaten people or objects on the ground, as not all debris is burned up on its way through the atmosphere.	Operational spacecraft are struck by small pieces of orbital debris and micrometeoroids routinely with little or no effect; many orbiting structures use shielding methods to protect from debris as large as 1 centimeter in diameter. The probability of two large objects colliding in space is very low, only one such documented incident has occurred between objects from different missions in 45 years.
Orbital Debris	PHO0002-5	Further, even short-term debris could be a danger to space objects such as the International Space Station, as the PEIS admits. And while the PEIS states that the ISS could be moved to avoid a collision with any large debris, it fails to recognize that other objects in low Earth orbit that might be threatened are not maneuverable.	See previous response.
Orbital Debris	PHW0003-4	Finally, the PEIS contradicts itself somewhat on the issue of debris risk by stating (on p. 4-132) that since the "debris created is expected to be small" and collision avoidance strategies could be used, there are "no	Because the development of a space-based test bed is too speculative to be analyzed in this PEIS, the specific impacts of launching interceptors from space-based platforms for BMDS testing would be considered in

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		significant impacts expected to the ISS." While it is debatable whether the debris would indeed be "small" - as the PEIS provides no actual modeling to predict the size of debris created by a ground-based midcourse intercept -the fact is that small debris could actually be more dangerous to the ISS and other spacecraft in LEO. That is because current debris tracking systems cannot track debris smaller than 10 centimeters in diameter (about the size of a softball) adequately enough to allow planning of collision avoidance maneuvers. Debris between 10 cm and 1 cm in diameter (a bit larger than a marble) will penetrate and damage most spacecraft (as the PEIS admits on p. 4-131) and could possible destroy space assets depending on where debris strikes the spacecraft. It also should be noted that the orbital plane between 300 and 400 kilometers is already one of the bands of space most polluted with this size of debris.	subsequent analyses as appropriate. The MDA wanted to consider the broad possibilities of space-based interceptors as an alternative strategy to enhance the integrated BMDS recognizing that the technologies for this application are in initial stages of planning and development and that subsequent NEPA analyses would likely be needed as technologies and plans became more mature.
Orbital Debris	PHO0002-11	Last of all, the PEIS also neglects a critical factor regarding the potential for debris creation from SBIs: that is, the fact that any architecture means large numbers of missiles filled with highly volatile rocket fuel would be orbiting in LEO at altitudes where they themselves will be constantly bombarded by space debris, with an attendant risk of explosion caused by debris impact.	See previous response.
Orbital Debris	PHW0003-5	The PEIS completely fails to support its claim that there would be no significant impact to spacecraft from the use of Space-Based Interceptors (SBIs) for either boost-phase intercept (as an ICBM is rising into the upper atmosphere) or midcourse intercept, due to the inability of the MDA to provide data required for necessary scientific review.	See previous response.

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		Given the inadequate articulation by MDA of the SBI concept and the lack of sufficient scientific coverage of space debris in this PEIS, it is impossible for the PEIS to make any claims about potential debris production from SBI tests, deployment or usage - other than that the creation of debris is a certitude. The PEIS states (p. 4-118), "Using interceptors from a space-based platform would create orbital debris, from successfully intercepting a threat missile and causing it to break up or from the break up of any unsuccessful interceptor or space platform." It further notes (p. 4-118) that SBIs would travel through space after launch, and thus potentially endanger other satellites it their path. It does not, however, mention the fact that launching an SBI constellation into either LEO or GEO would also have debris impacts that might be significant.	
Orbital Debris	PHW0003-6	The dangers of the debris created, however, can not be scientifically analyzed because the configuration of the SBIs themselves (i.e., their size, mass and speed) has yet to be revealed by MDA; neither has the architecture for their deployment (how many SBIs on orbit and at what altitude) or usage (how many SBIs would be fired at an incoming target) been publicly determined. As noted above, the potential for debris creation depends on a number of factors including the mass of the two objects, the speed of the impact, the altitude of the impact, and the angle of impact. With none of the specific parameters identified for a SBI system by MDA (including in this PEIS), these factors are impossible to model.	See previous response.
Orbital Debris	PHW0003-8	Third, and perhaps the most egregious inadequacy in the PEIS review of the SBI option, proposals for a SBI	See previous response.

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		network postulate between 500 and several thousand interceptors in LEO - each of which would be filled with a large amount of highly-volatile rocket fuel. Thus, the SBIs themselves would be in potential danger of colliding with space debris already on orbit. Such collisions could result in the explosion of the SBI. In fact, current orbital debris mitigation regulations in the United States and elsewhere, as a first-order priority, require space operators to vent any excess fuel from booster rockets used in launching satellites in order to avoid on-orbit explosions, which are proven to create vast amounts of wide-spread debris. The SBIs would also be constantly bombarded by smaller debris that could comprise their integrity. The PEIS completely ignores the possibility of SBIs being damaged by debris.	
Orbital Debris	PHW0003-9	And while the PEIS suggests the possibility that some SBIs also might be based in GEO, there is no effort to address the even more serious threats this architecture would pose to spacecraft. An SBI traveling toward the Earth from GEO would have many more opportunities to collide with other spacecraft as it passed through subsequently lower orbital altitudes. Also as GEO is already highly crowded with satellites (mostly for commercial communications and broadcast), the threat of debris creation by a network of new, explosive SBIs based in that orbital band could be high. Neither of these potential threats is modeled in the PEIS.	The BMDS PEIS states that space-based platforms for sensors or C2BMC could be placed into GEO; however, there is no mention of placing space-based platforms for weapons into GEO. If future plans were to identify the need for the use of space-based platforms for weapons in GEO, they would be considered in subsequent tiered analyses, as appropriate.
Orbital Debris	PHW0003-10	Indeed, the PEIS itself states (p. 4-116) that "additional environmental analysis could be needed as the technologies intended to be used became more defined and robust." Even more worrisome, an article in the Sept.	The MDA coordinates its activities with appropriate Federal agencies. The MDA participates in a Working Group studying the characterization of operational engagement space (i.e., conducting high speed, high

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		13 edition of Space News ("Space-Based Interceptor Could Pose Debris Threat") reveals that MDA has not even held detailed discussions about the potential for damaging debris from space-based interceptors with NASA's Orbital Debris Program Office.	altitude intercept scenarios to test GMD) with respect to debris risk. Members of the analysis working group include MDA, NASA, U.S. Air Force Space Command (AFSPC), the Aerospace Corporation, and System Test and Evaluation Planning Analysis Lab (STEPAL). The policy component of this working group includes NASA, AFSPC, STRATCOM, National Reconnaissance Office (NRO), and the Pacific Range Support Team (PRST). MDA is conducting modeling in this venue to try to consider realistic test scenarios and considering debris risk at the ground/surface and in space with the goal of developing criteria for protecting space assets. These efforts are currently underway.
Orbital Debris	PHW0003-11	The PEIS states on a number of occasions that any debris reentering the atmosphere from a midcourse intercept (by either ground-based or space-based interceptors) event would likely be "small" and thus "burn up" before impacting the ground. Considering that a Delta 2 second stage is a good bit smaller than either an ICBM or the current design of the ground-based midcourse interceptor, that statement is debatable. Nor is it supported by the PEIS itself, which simply does not provide the scientific analysis needed to determine the size of debris created by a midcourse intercept or the possibility of it making landfall intact	MDA has conducted an exhaustive study of the risks posed to spacecraft. Results are being coordinated with the space community. This analysis has shown that the majority of post-intercept debris resulting from high altitude intercepts would reenter the atmosphere within a few hours. A small amount of post-intercept debris may become orbital debris; however, risks to spacecraft from this debris are less than the risk posed by existing background debris. The MDA has created a technical appendix to the PEIS (see Appendix L), which provides additional information on the creation and reentry of orbital debris.
Orbital Debris	PHW0003-12	For example, in the case of a booster malfunction or a miss by an interceptor successfully launched from the ground, large pieces of debris likely would fall back to Earth. There is little evidence given in the PEIS to back its contrary assertion that debris would be small and limited in its "footprint." Even in the case of a successful	As part of the normal mission planning process, scenarios are designed so that in the event of a flight termination action, all debris will impact the open ocean or designated areas on land ranges. Booster drop zones, flight termination and intercept debris footprints are coordinated with the appropriate test range authorities.

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		intercept, there is no data provided by the PEIS about the likely size and altitude of debris, data that is required to predict whether or not pieces would make landfall intact.	
Orbital Debris	PHO0002-10	Number Two: The PEIS fails to support its claim that there would be no significant impact to spacecraft and satellites, and objects and people on the ground, from the testing and deployment of Space-Based Interceptors. Given the inadequate articulation by MDA of the SBI concept itself, it is impossible for the MDA to make any claims about the risks to space objects from SBIs. Debris creation depends on a number of specific factors about individual impacts, such as the mass of the two objects impacting, their relative velocities at impact, the angle of impact, and altitude. Since the MDA has yet to determine nor to provide in this PEIS critical design parameters of the SBIs themselves--their size, mass, and their speed--and the architecture of an SBI network, how many interceptors on orbit at what altitude--it is simply impossible for the MDA to support the PEIS claim that there is little debris risk, much less to support the PEIS suggestion that a space-based architecture would present less risk to the environment than a solely ground-based one. Without any specific parameters for an SBI network available, the MDA has no data for undertaking the necessary calculations to support its claims.	As stated in Section 4.2.1, during testing the MDA would select launch scenarios that would result in both the interceptor and intercept debris clouds impacting in designated areas within the ocean or on cleared land-based ranges. Because the development of a space-based test bed is too speculative to be analyzed in this PEIS at this time, further analysis would be conducted as the space-based technology develops and matures.
Orbital Debris	PHW0003-13	As the size, mass and speed of any SBI remains undetermined by MDA, it is impossible for the MDA at this time claim that there would be little risk of landfall by debris. However, the possibility of an SBI missing its	See previous response.

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		target and reentering the atmosphere is worrisome, and should be further reviewed using reentry modeling based on several SBI configuration options - modeling that has not been provided by the PEIS.	
Orbital Debris	PHW0003-14	The PEIS (p. 4-70) also states that "even if an object does survive reentry, only one third of the Earth's surface is land area, and only a small portion of this land area is densely populated. The chance of hitting a populated land area upon reentry would be small." While this is a statement of fact, it does not take into account the trajectory of likely missile tests or intercepts over the Earth. Where reentry might happen is dependent on from where the target missile is launched as well as from where the interceptor is launched, and at what point in their individual trajectories impact is made. The PEIS fails to provide specific data about likely intercept scenarios required to model possible reentry points. For example, there is some question about MDA's ability to do intercept tests from Ft. Greely, the first location for the new ground-based midcourse interceptors, because of concerns about endangering people and the environment. Finally, the PEIS itself admits (p. 4-122) that "Objects reentering may skip off the Earth's atmosphere, similar to a stone skipping across a pond, causing them to impact much farther away than originally predicted."	The PEIS is intended to provide a programmatic analysis of the potential impacts associated with the development, testing, deployment, and decommissioning of the BMDS. The PEIS is not a site- or component-specific environmental analysis and therefore does not provide specific information about particular components or their operation at various facilities. Specific booster or debris impact zones are coordinated with the appropriate test range authority months if not years prior to a mission. Moreover, coordination is conducted for every mission. If future plans identify specific locations that are required to support specific target and interceptor launches, they would be considered in subsequent tiered NEPA analyses, as appropriate.
Orbital Debris	PHW0003-15	In the case of a SBI launch designed to hit an ICBM in its boost phase, it is currently (as with a midcourse design) impossible to predict with reliability the potential for debris to make landfall intact due to the lack of data about the configuration of SBIs. That said, however, a miss likely would result in major ground impact. That is	There is no reason to believe that if there is a miss during a future test involving a space-based interceptor that there would be major impact on the ground. Although it is completely speculative at this point, a space-based interceptor intended for use as a test article would likely be fitted with a flight termination system to preclude an

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		because by any design, an SBI must be able to survive reentry of the atmosphere so as to hit the target ICBM before it exits the atmosphere. This issue is not addressed by the PEIS at all - and represents a fact that seems to run directly counter to the PEIS's assertion (p. 4-121) that, "Upon reentry, the majority of the space-based interceptor and its platform would burn due to the intense friction and heat created during reentry through the Earth's atmosphere."	intact interceptor from reaching the surface of the Earth. Further, a missed intercept would likely bounce off the atmosphere and spin out into space. The altitude and trajectory for space-based boost phase intercepts have not yet been determined; however, the space platform (vehicle) itself would likely leave its parking orbit upon communication that a boost phase engagement was to occur, it would likely deploy one or more kill vehicles (multiple mini-kill vehicles) that would serve as the boost phase interceptors, and the space platform would then return to its parking orbit.
Orbital Debris	PHW0003-16	Finally, the PEIS admits that any accident (such as a communications failure caused by a defect or jamming) that caused an SBI to reenter the Earth's atmosphere in an uncontrolled manner could create a danger to aircraft in flight. It states (p. 4-121), "Given the difficulty in predicting that path of uncontrolled reentering space-based interceptors and their associated platforms, little advanced warning could be given to clear airspace." It then goes on to assert that most objects break up upon reentry and the impacts to airspace would not likely be significant - an assertion for which no scientific backup is provided, especially given the fact that SBIs designed for boost-phase intercept would by their nature be required to reenter at least the upper atmosphere intact. Further, even smaller pieces of white-hot debris could severely damage an aircraft in flight.	Assuming a space platform with kill vehicles awaits communication of a boost phase engagement, it would come out of parking orbit and deploy one or more kill vehicles that would serve to intercept the target, and then return to orbit. The technologies for space-based interceptors are simply not mature enough to state for certain whether they would break up, burn up or reenter intact given their intended use especially as test articles. However, testing involving space-based boost phase intercepts would always take place in restricted airspace after ensuring that NOTAMs have been issued and the airspace has been cleared prior to test activities. It is extremely unlikely that a test scenario would result in danger to aircraft because the scheduling and safety restrictions prior to and during testing are stringent and are rigorously applied to ensure that this type of accident does not happen.
Orbital Debris	PHO0002-7	That said, the PEIS does not provide adequate scientific review to support the assertion that most debris would be small, a term that is undefined in the PEIS, raising the	The MDA has created a technical appendix to the PEIS (see Appendix L), which provides additional information on the creation, reentry, and disposition of orbital debris.

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		question of the risks from reentry into the atmosphere of both the interceptor and its target after an impact.	
Orbital Debris	PHO0002-8	Not all debris reentering the atmosphere burns up, as the PEIS suggests.	See previous response.
Orbital Debris	PHO0002-9	In January 1997, a Delta Two rocket second stage came down over Georgetown, Texas, with large pieces making landfall including a 580-pound stainless-steel fuel tank that landed 50 yards from a house. Another Delta Two second stage reentered the atmosphere over Cape Town, South Africa in April 2000, similarly raining large pieces of debris to the ground. It is important to note that a Delta Two second stage is considerably smaller than the either a ground-based midcourse interceptor or a target ICBM. It also is highly difficult to predict reentry trajectories even from scripted test events because debris can, as the PEIS admits, skip off the atmosphere and land miles away from its original reentry point, and the PEIS provides no evidence that MDA made any significant effort to undertake the complex computer modeling required to predict such possible reentry scenarios.	The MDA has performed modeling of high altitude ground-based intercepts. This modeling has shown that the majority of post-intercept debris resulting from high altitude intercepts would reenter the atmosphere within a few hours. A small amount of post-intercept debris may become orbital debris; however, risk to spacecraft from this debris is less than the risk posed by existing background debris. The MDA has added a technical appendix to the PEIS (see Appendix L), which provides additional information on the creation and reentry of orbital debris.
Orbital Debris	PHO0002-12	The PEIS ignores this risk altogether. In sum, the PEIS fails to support its conclusions about the risk from the creation of orbital debris and its possible reentry into the atmosphere due to a lack of adequate and complete scientific review.	See previous response.
Perchlorate	E0319-24	The PEIS should include any environmental health hazard studies the Department of Defense (DOD) has done since 1997 on children living in communities near rocket/missile launch sites and/or U.S. military training bases world-wide. An excerpt from an October 1, 2004 DOD news release titled: 'DOD, California Perchlorate	Section 4.1.1.2 of the Draft PEIS provided information developed by the Perchlorate Study Group, this group worked with the U.S. EPA, NASA, state governments, water purveyors, and other business organizations to assess whether there is a level of perchlorate in drinking water that poses a risk to human health. In addition to

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		Sampling Prioritization Protocol Reached', stated: "Currently, no drinking water standard for perchlorate has been adopted". According to the news article, the DOD apparently is finally agreeing to involve itself with environmental studies, along with the state of California, to research the findings of large quantities of perchlorates in the state's drinking water. Since perchlorate is a rocket and missile propellant, and there have been no previous drinking water standards for the chemical, the PEIS cannot state without conclusive studies that there has been no health and safety risks to children (or the general public) who live near test launch sites.	citing the Perchlorate Study Group findings, the Final PEIS has been modified to include the proposed findings from the State of California Office of Environmental Health Hazard Assessment, the State of Massachusetts, and U.S. EPA. The U.S. EPA has established an official reference dose (RfD) of 0.0007 milligrams per kilogram (mg/kg) per day of perchlorate, which translates into a drinking water equivalent level of 24.5 parts per billion (ppb). A Drinking Water Equivalent Level, which assumes that all of a contaminant comes from drinking water, is the concentration of a contaminant in drinking water that will have no adverse effect with a margin of safety. Because there is a margin of safety built into the RfD and the drinking water equivalent level, exposures above the drinking water equivalent level are not necessarily considered unsafe. To better characterize some of the potential impacts associated with proposed BMDS activities, additional information and research on perchlorate has been added to Section 4.1.1.2 of the Final PEIS. Further, a technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS.
Perchlorate	E0326-1	The testing of the system at Vandenberg AFB has inevitably had the effect of polluting the surrounding area with perchlorates. We do not know the extent of birth defects and growth retardation caused by rocket fuel in	The DoD and the MDA are aware of the potential health concerns associated with perchlorate contamination. The DoD, U.S. EPA, DOE, and NASA asked the National Research Council (NRC) to assess independently the adverse health effects of perchlorate ingestion from

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		this area because no studies among this population have been done.	clinical, toxicological, and public health perspectives. The NRC study considered thyroid function in infants including possible impacts from perchlorate exposure on birth defects and skeletal growth. Regarding birth defects resulting from non-normal thyroid function the NRC study states: *"The consequences of severe combined maternal and fetal hypothyroidism during fetal life and in newborn infants include microcephaly (small brain), mental retardation, deaf-mutism, paraplegia or quadriplegia, and movement disorders. Those abnormalities are not reversible by treatment with T4 (Foley 2000). However, the abnormalities can be largely prevented by administration of iodide to the mothers before or during the first trimester and early part of the second trimester of pregnancy (Pharoah 1993; Cao et al. 1994)."* Regarding impacts to skeletal growth from non-normal thyroid function, the NRC study states: *"T4 and T3 also are required for normal skeletal development and growth. Bone cells have T3 receptors, and T3 stimulates bone formation and the appearance of the epiphyseal centers that are needed for normal growth of long bones. T3 also stimulates the production of pituitary growth hormone and insulin-like growth factor. Treatment with T4 leads to resumption of bone growth and*

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			skeletal maturation, but severely affected infants are unlikely to have normal stature." In addition, the NRC report noted that "The primary sources of uncertainty in estimating an RfD for perchlorate in drinking water arise from the absence of data on possible side effects of iodide deficiency (pregnant women and their fetuses and newborns). Therefore, new epidemiologic research should assess the possible health effects of perchlorate exposure in those populations." Section 4.1.1.2 of the Draft PEIS provided information developed by the Perchlorate Study Group, this group worked with the U.S. EPA, NASA, state governments, water purveyors, and other business organizations to assess whether there is a level of perchlorate in drinking water that poses a risk to human health. The Final PEIS has been modified to include the proposed findings from the State of California Office of Environmental Health Hazard Assessment, the State of Massachusetts, and U.S. EPA. To better characterize some of the potential impacts associated with proposed BMDS activities, additional information and research on perchlorate has been added to Section 4.1.1.2 of the Final PEIS. Further, a technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS. The appendix considers the uses, sources, and disposal of perchlorate as well as the effects on human health and the

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			environment. It should be noted that future tiered analyses for specific proposed activities at sites such as Vandenberg AFB would appropriately consider the potential impacts of activities on water quality.
Perchlorate	E0363-1	In particular, I am concerned about the hazardous waste associated with the system. For example, perchlorate from rocket fuel has already contaminated rivers and ground water, and can find its way into milk supplies (e.g., as has occurred in Texas). Like other toxins that act as endocrine disruptors, perchlorate can interfere with thyroid hormones and disrupt pre- and post-natal brain development, resulting in reductions of IQ and attention, mental retardation, hearing loss, and defects in speech and coordination. Seventeen percent of children suffer from developmental and learning disabilities, and as many as 25% of those disabilities are due to the effects of environmental toxins either acting alone or in combination with genetic and other environmental factors.	The DoD and the MDA are aware of the potential health concerns associated with perchlorate contaminated water. However, currently, there are no Federal drinking water standards for perchlorate. The U.S. EPA would be responsible for establishing Federal drinking water standards and has issued draft risk assessments of perchlorate. However, these assessments have been criticized because it has been suggested that the findings are based on flawed scientific studies and that not all available data were considered and incorporated into the assessments. The U.S. EPA study's draft RfD for perchlorate was 0.00003 mg/kg per day and the NRC study recommended an RfD of 0.0007 mg/kg per day. The NRC stated that this value is supported by other clinical studies, epidemiologic studies, and studies of long-term perchlorate administration. The NRC report concluded that the proposed RfD of 0.0007 mg/kg per day should protect even the most sensitive populations. The U.S. EPA has established an official RfD of 0.0007 mg/kg per day of perchlorate, which translates into a drinking water equivalent level of 24.5 ppb. A Drinking Water Equivalent Level, which assumes that all of a contaminant comes from drinking water, is the concentration of a contaminant in drinking water that will have no adverse effect with a margin of safety. Because there is a margin of safety built into the RfD and the drinking water equivalent level, exposures above

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			the drinking water equivalent level are not necessarily considered unsafe. To better characterize some of the potential impacts associated with proposed BMDS activities, additional information and research on perchlorate has been added to Section 4.1.1.2 of the Final PEIS. Further, a technical Appendix M addressing issues specifically related to perchlorate has been added to the Final PEIS.
Perchlorate	PHO0025-1	This weapons system is designed to intercept enemy missiles in space from ground platforms in Fort Greely, Alaska, Vandenberg Air Force Base in Southern California. The chemicals used in solid rocket propellant that would be used to launch the intercept missiles, the test missiles and especially the booster rockets that place related detection communication satellites in space would all use imodium perchlorates as the oxidizing agent in the rocket fuel. The fuel would also contain highly toxic hydrazine compounds and nitrogen oxide. In the news of late, the developmental toxin perchlorate has been found in many of our nation's drinking water sources. This chemical inhibits thyroid hormone creation and release. In low doses, perchlorate is presumed to decrease the intelligence potential of a developing fetus. In cases of more severe exposure, can cause frank retardation. Additionally, once combusted and exposed to air moisture, perchlorates create hydrochloric acid, more commonly known as "acid rain."	The DoD and the MDA are aware of the potential health concerns associated with perchlorate contaminated water. In 1985, perchlorate was detected in wells of California Superfund sites; however, perchlorate contamination was not detected nationwide until 1997. Currently, there are no Federal drinking water standards for perchlorate. The DoD, U.S. EPA, DOE, and NASA asked the NRC to assess independently the adverse health effects of perchlorate ingestion from clinical, toxicological, and public health perspectives. The NRC report considered the potential health effects to children born to mothers with non-normal thyroid function and found that *"Those studies, although not definitive, suggest an effect on development in infants whose mothers had subclinical hypothyroidism or low-normal serum free T4 concentrations during pregnancy, but they have limitations. The differences in test scores were small, and the scores could be confounded by socioeconomic, educational, and other differences*

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			between the study groups. Moreover, the results contrast with the normal development of the infants of mothers who had overt hypothyroidism (Liu et al. 1994). Nonetheless, if confirmed, they emphasize the potential vulnerability of fetuses to decreases in maternal thyroid function." A technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS. Section 4.1.1.2 of the Final PEIS considers the impacts of exhaust products from solid propellant boosters; including the impact from the conversion of hydrogen chloride to hydrochloric acid.
Perchlorate	E0376-1	In the draft Programmatic Environmental Impact Statement for the Missile Defense System (1 September 2004), I would like to point out incomplete and misleading statements about perchlorate toxicity and standards in the bottom paragraph on Vol. 1, p. 4-56. This discussion provides the viewpoint of the DoD and the Perchlorate Study Group, an Industry Workgroup, on perchlorate toxicity, but ignores all risk assessments conducted by actual risk assessment agencies. The U.S. EPA has been evaluating perchlorate toxicity for years, in association with several defense agencies (as stated), and has released a draft risk assessment which proposes a drinking water equivalent level of 1 ppb. The State of California Office of Environmental Health Hazard Assessment has published our risk assessment	In addition to citing the Perchlorate Study Group findings, the Final PEIS has been modified to include the proposed findings from the State of California Office of Environmental Health Hazard Assessment, the State of Massachusetts, and U.S. EPA. To better characterize some of the potential impacts associated with proposed BMDS activities, additional information and research on perchlorate has been added to Section 4.1.1.2 of the Final PEIS. Further, a technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS. The appendix considers the uses, sources, and disposal of perchlorate as well as the effects on human health and the environment.

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		which estimates a health-protectice level of perchlorate in drinking water of 6 ppb. The State of Massachusetts has recently released their evaluation with a recommended drinking water level of 1 ppb to protect pregnant women and fetuses (or other sensitive sub-populations), and 18 ppb for healthy adults. The U.S. EPA guidance applicable to water contaminant plumes emanating from industrial and DoD sites has used a standard of 4-18 ppb for several years. To not consider and apply these relevant and applicable standards to the evaluation of potential environmental impact of the deployed missile systems seems to me to be putting both the DoD and the public at risk, both from legal liability and potential chemical hazards. I recommend that this section of the report, and any financial and toxicological calculations based on it, be revised to include the viewpoints expressed by the regulatory agencies whose job it is to regulate the public and environmental exposure to perchlorate. Acknowledging these opinions need not wait for the finalization of the U.S. EPA's current draft risk assessment for perchlorate, currently under review by the National Academy of Sciences, nor the promulgation of the California Maximum Contaminant Level for perchlorate in drinking water, scheduled for 2005.	
Perchlorate	E0427-7 and E0439-7	8) Ammonium perchlorate is one of the main components of rocket fuel, typically constituting 60% to 75% of missile propellant and about 70% of space shuttle rocket motors. Since the fuel and perchlorate goes flat, the fuel/perchlorate has to be replaced every few years or it	Section 4.1.1.2 of the Draft PEIS provided information developed by the Perchlorate Study Group, this group worked with the U.S. EPA, NASA, state governments, water purveyors, and other business organizations to assess whether there is a level of perchlorate in drinking

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		will fail to function properly, thereby increasing the amount of perchlorate waste and exposure problems. Ammonium Perchlorate is well characterized as a thyroid hormone disruptor. http://www.ewg.org/reports/rocketscience/chap3.html. At high enough concentrations, perchlorate can affect thyroid gland functions, where it blocks iodide uptake necessary for the synthesis of thyroid hormones (Urbansky 2002). Perchlorate can cause hypothyroidism, and thyroid cancer. The environmental levels of perchlorate have been show to inhibit development in frogs (Goleman et al. 2002). California has extensive perchlorate contamination problems with the drinking water sources of at least 7 million Californians and millions of other Americans are contaminated with perchlorate. A federal safe daily perchlorate exposure has not yet been set by the EPA, and its expected release in 2002 has been delayed. It has been delayed since the DoD objected to EPA studies suggested a standard of 1 ppb. Senator Barbara Boxer has introduced legislation to require the EPA to establish a standard for perchlorate contamination by July 1, 2004. While most contaminated samples are in the 4 to 20 ppb levels, surveys of California water sources show several sites with perchlorate levels from 4 to 820 ppb. http://www.ewg.org/reports/rocketwater/tablel.php Ammonium perchlorate used in solid propellants blocks the formation of key thyroid hormones which are critical for growth and development especially in fetuses and children. The PEIS proposes to allow over 30-fold higher levels of perchlorate (200 parts per billion) than that proposed by the State of California (6 parts per billion).	water that poses a risk to human health. In addition to citing the Perchlorate Study Group findings, the Final PEIS has been modified to include the proposed findings from the State of California Office of Environmental Health Hazard Assessment, the State of Massachusetts, and U.S. EPA. Currently, there are no Federal drinking water standards for perchlorate. The U.S. EPA would be responsible for establishing Federal drinking water standards and has issued draft risk assessments of perchlorate. However, these assessments have been criticized because it has been suggested that the findings are based on flawed scientific studies and that not all available data were considered and incorporated into the assessments. The U.S. EPA study's draft RfD for perchlorate was 0.00003 mg/kg per day and the NRC study recommended an RfD of 0.0007 mg/kg per day. The NRC stated that this value is supported by other clinical studies, epidemiologic studies, and studies of long-term perchlorate administration. The NRC report concluded that the proposed RfD of 0.0007 mg/kg per day should protect even the most sensitive populations. The U.S. EPA has established an official RfD of 0.0007 mg/kg per day of perchlorate, which translates into a drinking water equivalent level of 24.5 ppb. A Drinking Water Equivalent Level, which assumes that all of a contaminant comes from drinking water, is the concentration of a contaminant in drinking water that will have no adverse effect with a margin of safety. Because there is a margin of safety built into the RfD

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		As pointed out in the comments of Lenny Siegel: The reason that there is no federal drinking water standard for perchlorate is that the Defense Department objected to EPA studies that suggested a standard of one part per billion (ppb). Meanwhile, regulatory agencies are using levels far below the 200 ppb asserted in the PEIS. On the way to establishing its own legal standard, California has adopted a Public Health Goal of 6 ppb (Frequently Asked Questions (FAQs) About the Public Health Goal for Perchlorate," California Office of Environmental Health Hazard Assessment (OEHHA), March 11, 2004. hittp:/www.oehha.ca.gov/public_info/facts/perchloratesfac ts.html). Even these levels of perchlorate may be detrimental to fetuses and infants. The human study considered in setting the California public health goal did not evaluate pregnant women, fetuses or infants (Greer et al. 2002). The study of Greer at al 2002, only used a 14-day exposure to perchlorate, which is insufficient to deplete thyroid colloid which acts as a storage form of thyroid hormones. Thus this study is insufficient to estimate the effect of long-term perchlorate exposure on iodine uptake or thyroid hormone levels. Since the effect of long term perchlorate exposure on reducing thyroid hormone levels, especially in the fetus and in infants has not been considered, the MDA needs to evaluate these effects on these sensitive groups as required by federal law. In May, 2004, Massachusetts identified a reference dose for perchlorate that would correspond to a 1 ppb drinking water exposure limit. Also note that perchlorate	and the drinking water equivalent level, exposures above the drinking water equivalent level are not necessarily considered unsafe. To better characterize some of the potential impacts associated with proposed BMDS activities, additional information and research on perchlorate has been added to Section 4.1.1.2 of the Final PEIS. Further, a technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS.

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		is found in milk and in several plant species, including lettuce, where high levels have been reported. Thus multiple sources of perchlorate exposure need to be considered.	
Perchlorate	E0427-8 and EO439-8	9) To ensure maximum environmental protection and reduce known, widespread human health risks from the use and disposal of rocket propellants, the BMDS PEIS should compare the proposed alternatives against a real No Action Alternative. At a minimum the BMDS PEIS should: A. Acknowledge and address emerging regulatory standards for perchlorate exposure. B. Consider the effects of perchlorate on susceptible subpopulations, including fetuses, and children. The MDA also needs to consider the effects of perchlorate exposure on even more sensitive congenitally hypothyroid populations, so that these individuals are not detrimentally affected by perchlorate from BMDS missile launches. C. Since water supplies in several regions of central and southern California are already at, exceeding and in some cases markedly exceeding the emerging regulatory standards for perchlorate, the MDA should acknowledge and address the perchlorate problem so as to protect the public.	The DoD and the MDA are aware of the potential health concerns associated with perchlorate contaminated water. In 1985, perchlorate was detected in wells of California Superfund sites; however, perchlorate contamination was not detected nationwide until 1997. Currently, there are no Federal drinking water standards for perchlorate. The U.S. EPA would be responsible for establishing Federal drinking water standards and has issued draft risk assessments of perchlorate. However, these assessments have been criticized because it has been suggested that the findings are based on flawed scientific studies and that not all available data were considered and incorporated into the assessment. The U.S. EPA study's draft RfD for perchlorate was 0.00003 mg/kg per day and the NRC study recommended an RfD of 0.0007 mg/kg per day. The NRC stated that this value is supported by other clinical studies, epidemiologic studies, and studies of long-term perchlorate administration. The NRC report concluded that the proposed RfD of 0.0007 mg/kg per day should protect even the most sensitive populations. The U.S. EPA has established an official RfD of 0.0007 mg/kg per day of perchlorate, which translates into a drinking water equivalent level of 24.5 ppb. A Drinking Water Equivalent Level, which assumes that all of a contaminant comes from drinking water, is the concentration of a contaminant in drinking water that

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			will have no adverse effect with a margin of safety. Because there is a margin of safety built into the RfD and the drinking water equivalent level, exposures above the drinking water equivalent level are not necessarily considered unsafe. The NRC report noted that "The primary sources of uncertainty in estimating an RfD for perchlorate in drinking water arise from the absence of data on possible side effects of iodide deficiency (pregnant women and their fetuses and newborns). Therefore, new epidemiologic research should assess the possible health effects of perchlorate exposure in those populations." The Council's report further stressed that "Finally, in its deliberations on the health effects of perchlorate in drinking water, the committee considered pregnant women and their fetuses to be particularly sensitive populations." Epidemiologic studies considered by the NRC have examined the relationship between perchlorate exposure and thyroid function and thyroid disease in newborns, children, and adults. The NRC concluded that no studies have investigated the effect of perchlorate exposure in vulnerable groups, such as low-birth weight or preterm infants. In addition, these studies have not considered the impacts to the offspring of mothers who were exposed to perchlorate and had a low iodide intake. Finally, adequate studies have not been completed of maternal perchlorate exposure and neurodevelopment outcomes in infants.

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			To better characterize some of the potential impacts associated with proposed BMDS activities, additional information and research on perchlorate has been added to Section 4.1.1.2 of the Final PEIS. Further, a technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS.
Perchlorate	E0429-5, E0429-24, PHW0004-5, PHW0004-24	1. Provide more detailed estimates of perchlorate waste likely to be generated by system development, testing, deployment, maintenance, and decommissioning and acknowledge emerging regulatory standards for perchlorate exposure.	This PEIS is not intended to analyze specific testing or deployment of defined missile defense architecture. Therefore, it is not possible to provide detailed estimates of perchlorate likely to be generated by BMDS-related activities. The MDA has stated that the disposal of hazardous materials and hazardous wastes would be conducted in compliance with applicable regulations. Currently, there are no Federal drinking water standards for perchlorate. The U.S. EPA would be responsible for establishing Federal drinking water standards and has issued draft risk assessments of perchlorate. However, these assessments have been criticized because it has been suggested that the findings are based on flawed scientific studies and that not all available data were considered and incorporated into the assessment. The U.S. EPA study's draft RfD for perchlorate was 0.00003 mg/kg per day and the NRC study recommended an RfD of 0.0007 mg/kg per day. The NRC stated that this value is supported by other clinical studies, epidemiologic studies, and studies of long-term perchlorate administration. The NRC report concluded that the proposed RfD of 0.0007 mg/kg per day should protect even the most sensitive populations. The U.S. EPA has

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			established an official RfD of 0.0007 mg/kg per day of perchlorate, which translates into a drinking water equivalent level of 24.5 ppb. A Drinking Water Equivalent Level, which assumes that all of a contaminant comes from drinking water, is the concentration of a contaminant in drinking water that will have no adverse effect with a margin of safety. Because there is a margin of safety built into the RfD and the drinking water equivalent level, exposures above the drinking water equivalent level are not necessarily considered unsafe. Section 4.1.1.2 of the Final PEIS has been modified to include the proposed findings from the State of California Office of Environmental Health Hazard Assessment, the State of Massachusetts, and the U.S. EPA, as well as the results of the NRC study, *Health Implications of Perchlorate Ingestion*. Further, a technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS.
Perchlorate	E0429-23, PHW0004-23	The Army should follow the advice of the Air Force contractors and conduct site-specific analysis of the impact of perchlorate debris on any freshwater lake that might receive perchlorate debris as well as confined oceans waters, such as within the Marshall Islands, where repeated releases of perchlorate could damage sensitive ecosystems or essential food supplies. It should also work with NASA and the Air Force to ground-truth models on perchlorate releases by conducting actual water, soil, and sediment sampling for perchlorate at major launch	The PEIS has been modified to include additional information on perchlorate including more detailed information from the series of studies conducted by the Aerospace Corporation. As stated throughout the PEIS, this document is intended to serve as a tiering document from which future site-specific NEPA analyses will be tiered. These site-specific analyses can consider the potential impacts to individual water bodies that may be impacted by solid propellant debris. The proposed

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		facilities such as Cape Canaveral and Vandenberg Air Force Base.	BMDS activities would be conducted in compliance with all applicable regulations regarding perchlorate.
Perchlorate	F0005-12	The PEIS should provide more detailed estimates of perchlorate waste likely to be generated by system development, testing, deployment, maintenance, and decommissioning, and acknowledge the potential impacts of such exposure.	This PEIS is not intended to analyze specific testing or deployment of defined missile defense architecture. Therefore, it is not possible to provide detailed estimates of perchlorate likely to be generated by BMDS-related activities. The MDA has stated that disposal of hazardous materials and hazardous wastes will be conducted in compliance with applicable regulations. The DoD and the MDA are aware of the potential health concerns associated with perchlorate contaminated water. To better characterize some of the potential impacts associated with proposed BMDS activities, additional information and research on perchlorate has been added to Section 4.1.1.2 of the Final PEIS. Further, a technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS. The appendix considers the uses, sources, and disposal of perchlorate as well as the effects on human health and the environment.
Propellant	E0402-6	3) Rocket launches result in incredible amounts of chemical releases. Liquid propellants containing hydrazines, nitrogen tetraoxide, and other compounds are highly toxic to all living species. Ammonium perchlorate used in solid propellants blocks the formation of key thyroid hormones which are critical for growth and development especially in fetuses and children. The PEIS proposes to allow over 30-fold higher levels of perchlorate (200 parts per billion) than that proposed by the State of California (6 parts per billion).	The environmental impacts from the use of various liquid and solid propellants are discussed in Section 4.1.1.2 of the PEIS. This section of the Final PEIS has been modified to include additional information regarding the potential impacts of perchlorate. Further, a technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS. The appendix considers

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			the uses, sources, and disposal of perchlorate as well as the effects on human health and the environment.
Propellant	E0427-6, E0439-6	7) Liquid propellants containing hydrazines, nitrogen tetroxide, and other compounds are highly toxic. At very low concentrations, hydrazines irreversibly cross link to aldehyde groups on proteins at slightly acidic pH and can cause cancer. One of the most concerning pollutants from the firing of rocket engines is HC1, which combines with atmospheric water to produce acid rain. The PEIS did not address potential for interactions between HC1 and hydrazines commonly used in rocket engines such as monomethylhydrazine (MMH) and Unsymmetric dimethylhydrazine (UDMH). Specifically does the toxicity of hydrazine increase under acidic conditions found in acidic rocket exhaust?	Hydrazine and nitrogen tetroxide are hypergolic propellants and when used to power a rocket are not emitted in the rocket motor exhaust - they react without initiation to provide thrust to a rocket motor, resulting in emissions that include carbon monoxide, carbon dioxide, water, nitrogen, hydrogen, and nitrogen oxides. Hydrazine fuels are very reactive reducing agents that are hygroscopic and will react with carbon dioxide and oxygen in the air. However, hypergolic propellant systems do not generate hydrogen chloride, and thus would have no opportunity to interact with hydrogen chloride in the emission exhaust environment.
Propellant	E0429-4 and PHW0004-4	Perchlorate, primarily from the manufacturing, testing, aborted launches, maintenance, and decommissioning of solid rocket motors, is polluting the drinking water of more than twenty million people and may be endangering natural ecosystems from Cape Canaveral to the Marshall Islands. The PEIS understates the risks of exposure, and it fails to provide data on the quantities of solid rocket propellant likely to be produced, used, released, and disposed by the BMDS. The PEIS should consider the environmental consequences of various disposal strategies so the BMDS program can develop the technology or capacity to address its waste or consider the use of alternative launch technologies or strategies to minimize either the waste or the negative environmental impacts.	Section 2.1.3.2 of the BMDS PEIS describes the spiral development process which will be used to determine which components will be transitioned to the military service responsible for deployment, operation and maintenance. The PEIS does not attempt to detail the architecture of the deployed BMDS. The PEIS states "Thus the MDA can consider deployment of a missile defense system that has no specified final architecture and no set operational requirements but which will be improved incrementally over time." Therefore, it cannot be said with certainty how much propellant will be used or how often it will be necessary to dispose of propellant. A technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS. The appendix considers the uses,

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			sources, and disposal of perchlorate as well as the effects on human health and the environment. The BMDS PEIS considers the use of a wide variety of propellants including three types of boosters, pre-fueled liquid propellant, non-pre-fueled liquid propellant, and solid propellant boosters. The environmental impacts of the use of each of these three types of boosters are presented in Section 4.1.1.2 of the PEIS. In addition, DoD-wide research initiatives under the Strategic Environmental Research and Development Program have focused on the development of more environmentally-friendly launch technologies, such as missile propellants that do not use ammonium perchlorate as an oxidizer. While these alternate propellant formulations have shown promise, a significant amount of development remains to optimize the formulation for specific missile systems. In addition, these formulations will go through a lengthy and stringent performance and safety certification process. Because these alternative technologies are in a research and development phase and, are not yet advanced enough for their use to be reasonably foreseeable under NEPA, they are not analyzed in this PEIS. The MDA may consider the use of these alternative environmentally-friendly technologies as they become available in the future and meet the operational test requirements for the BMDS. Among launch technologies that are available today, the BMDS PEIS considers a wide variety of propellants used in three types of boosters, pre-fueled liquid propellant, non-pre-

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			fueled liquid propellant, and solid propellant boosters. The environmental impacts of each of these three types of boosters are presented in Section 4.1.1.2 of the PEIS. Additional information on perchlorate has been added to the PEIS text as well as a technical Appendix M on perchlorate. This appendix considers the uses, sources, and disposal of perchlorate as well as the human health and ecological risk of exposure to perchlorate.
Propellant	E0429-9 and PHW0004-9	However, liquid propellants, such as the hypergolic propellant containing hydrazine compounds and nitrogen tetroxide, are highly toxic, and the PEIS should consider how to minimize their environmental, health, and safety impacts as well.	See previous response.
Propellant	E0429-12 and PHW0004-12	The PEIS suggests that aluminum oxide, the other major combustion product of solid propellant, is non-toxic. (page 4-60) However, there is some evidence that aluminum in acid environments is toxic to fish. [Footnote 1: See, for example, Baker& Schofield, "Aluminum Toxicity to Fish in Acidic Waters," Water, Air, and Soil Pollution, 1987, cited in Heinz J. Mueller, Chief, Environmental Policy Section, Federal Activities Branch, U.S. EPA Region 4, "Environmental Assessment (EA) and Finding for No Significant Impact (FONSI) fro the Proposed Titan IV Upgrade Program. Cape Canaveral Air Force Station (CCAFS) and Kennedy Space Center (KSC), FL," letter to Captain Anothonly E. Fontana, III, Environmental Planning Division, Regional Civil Engineer, Eastern Region, Department of the Air Force, March 28, 1990.] The PEIS should review the literature and reconsider its conclusion based upon the weight of evidence.	MDA conducted a literature review for technical issues in this PEIS including the toxicity of Al_2O_3 which comprises the particulate matter in SRM emissions. The article indicated by the commenter refers to the increase in toxicity to fish of aluminum (as Al+3 ions) in acid waters (i.e., pH of 5 or less). Aluminum occurs naturally in soils/rock in such abundance that the amount of aluminum introduced into the atmosphere from Al_2O_3 emissions from the combustion of SRMs would be insignificant. Al_2O_3 also is naturally occurring in the environment and is used as an abrasive and polishing agent and is sold by many chemical supply companies. It is non-toxic, non-reactive and is not listed as a chemical of concern by the U.S. EPA or any Federal agency regulating toxic substances. Al_2O_3 is not toxic to humans or ecosystems. Al_2O_3 emissions might be of concern from a visibility perspective on the ground and

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			they have been studied as potential reaction sites in the stratosphere participating in the production of ozone. Neither has been determined to be significant impacts from BMDS launches.
Propellant	E0429-15 and PHW0004-15	Similarly, with the release of ozone-depleting compounds to the atmosphere, we as a society might decide that we shouldn't abruptly end space launches that depend upon solid rocket propellant. Instead, we might set a goal for the deployment of alternatively fueled rockets. The PEIS considers no such goal, despite the urgent need to mitigate global ozone depletion.	The PEIS did not conclude that launches related to BMDS activities would lead to significant impacts on global ozone depletion. Please refer to Section 4.1.1.2 of the PEIS for additional information on the potential impacts to the atmosphere of BMDS related launches. The BMDS PEIS considers the use of a wide variety of propellants including three types of boosters: pre-fueled liquid propellant, non-pre-fueled liquid propellant, and solid propellant. As new technologies and propellants are developed and found to meet the needs of supporting the BMDS they could be incorporated into the BMDS.
Propellant	E0429-16 and PHW0004-16	The Defense Department, NASA, and others have conducted research on propellants designed to achieve the thrust of ammonium-perchlorate-based fuels without the environmental hazards, but these efforts are poorly funded, and there appears to be no urgency. The BMDS program should at the very least, in its PEIS, evaluate the mitigation of seriously harmful environmental consequences through the development and deployment of alternative solid rocket propellants.	The BMDS PEIS considers the use of a wide variety of propellants including three types of boosters, pre-fueled liquid propellant, non-pre-fueled liquid propellant, and solid propellant boosters. The environmental impacts of each of these three types of boosters are presented in Section 4.1.1.2 of the PEIS. In addition, Appendix M includes DoD-wide research initiatives under the Strategic Environmental Research and Development Program that have focused on the development of more environmentally-friendly launch technologies, such as missile propellants that do not use ammonium perchlorate as an oxidizer. While these alternate propellant formulations have showed promise, a significant amount of development remains to optimize the formulation for specific missile systems. In addition, these formulations will go through a lengthy and

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			stringent performance and safety certification process. Since these alternative technologies are in a research and development phase and are not yet advanced enough for their use to be reasonably foreseeable under NEPA, they are not analyzed in this PEIS. The MDA may consider the use of these alternative environmentally-friendly technologies as they become available in the future and meet the operational test requirements for the BMDS. Among launch technologies that are available today, the BMDS PEIS considers a wide variety of propellants used in three types of boosters, pre-fueled liquid propellant, non-pre-fueled liquid propellant, and solid propellant boosters. The environmental impacts of each of these three types of boosters are presented in Section 4.1.1.2 of the PEIS.
Propellant	E0429-17 and PHW0004-17	Rocket fuel wastes, from manufacturing, testing, training, maintenance, and decommissioning are a significant environmental hazard. This is a front page news story from California to Massachusetts, but it is barely mentioned in the PEIS.	To better characterize some of the potential impacts associated with proposed BMDS activities, additional information on perchlorate has been added to Section 4.1.1.2 of the Final PEIS. Further, a technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS. The appendix considers the uses, sources, and disposal of perchlorate as well as the effects on human health and the environment.
Propellant	E0429-18, PHW0004-18	The PEIS should offer estimates of the quantities of solid rocket fuel that will be manufactured for the BMDS, not just for testing, but for missiles that will be deployed and hopefully never be launched. From that figure, it can estimate the quantities of manufacturing waste- propellant takes, chips, and wastewater-likely to be generated. The PEIS estimates that the BMDS program will launch 413	Section 2.1.3.2 of the BMDS PEIS describes the spiral development process which will be used to determine which components will be transitioned to the military service responsible for deployment, operation and maintenance. The PEIS does not attempt to detail the architecture of the deployed BMDS. The PEIS states "Thus the MDA can consider deployment of a missile

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		solid-propellant rockets, containing from under 500 kilograms (1,102 pounds) to 60,000 kilograms (132,277 pounds) of solid propellant each. About 70% of that propellant, by weight, will consist of ammonium perchlorate. But nowhere does it estimate what quantity of propellant will be contained in deployed missiles, or even how many missiles will be part of that system. Without that information there is no way to project the amount of propellant waste likely to be generated by the program.	defense system that has no specified final architecture and no set operational requirements but which will be improved incrementally over time." Therefore, it cannot be said with certainty how much propellant will be used or how often it will be necessary to dispose of propellant.
Propellant	E0429-19, PHW0004-19	Yet the PEIS appears not to address the environmental aspects of missile maintenance and it gives only cursory mention to decommissioning: Decommissioning of missiles would first require the removal and proper disposal of liquid, solid, or hybrid (liquid and solid combination) propellants from the booster(s). Where possible, propellants would be recovered and reused. Aging motors that contain flaws would likely be decommissioned using open detonation.... Solid rocket propellant would be removed for reclamation or burning in a controlled environment, such as an incinerator. Where practicable, incineration or closed burning of rocket propellant would be performed. Most of the acid and particulates ejected during the burn would be collected in plume scrubber water. This water would be treated for acceptance by a publicly owned (or federally owned) water treatment works in accordance with a National Pollutant Discharge Elimination System (NPDES) permit. (p. 4-16)	Section 4.0 of the BMDS PEIS describes how various activities including "maintenance and sustainment" were considered and analyzed in the PEIS. As described in Section 4.1.1.9, Exhibit 4-2 on Page 4-5, MDA did not consider missile maintenance further in this PEIS because it has been analyzed in previous NEPA documents. Decommissioning of missiles was discussed in Section 4 of the PEIS as identified in the comment. Beyond these activities, site and system specific decommissioning activities will be assessed in appropriate NEPA documentation tiered from the PEIS when decommissiong becomes the next step in the lifecycle of the component or system. Demilitarization and disposal of missile components will be performed in accordance with DoD Directives, Joint Service Regulations, and will comply with all applicable Federal and state regulations.
Propellant	E0429-20, PHW0004-20	Once again, the PEIS authors don't seem to be reading the newspapers. The disposal of solid rocket propellant	Section 2.1.3.2 of the BMDS PEIS describes the spiral development process which will be used to determine

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		through "hog-out" (washing out the propellant) or open burning/open detonation are some of the major sources of perchlorate contamination across the country. The PEIS should note how much propellant will be used, how often it will be necessary to dispose, and what the environmental impacts of each disposal or treatment method are likely to be. Such information is necessary, not just to estimate the life-cycle costs of the program, but also to figure out in advance how to reduce financial costs and environmental impacts through system redesign or ongoing mitigation activities. That's the purpose of the NEPA process.	which components will be transitioned to the military service responsible for deployment, operation and maintenance. The PEIS does not attempt to detail the architecture of the deployed BMDS. The PEIS states "Thus the MDA can consider deployment of a missile defense system that has no specified final architecture and no set operational requirements but which will be improved incrementally over time." Therefore, it cannot be said with certainty how much propellant will be used or how often it will be necessary to dispose of propellant. The DoD is exploring new technologies for disposal of ammonium perchlorate contaminated wastewater including using a biodegradation system and will use this and other new technologies as appropriate to dispose of wastewater. (U.S. Department of Defense, 2003. Joint Demilitarization Technology Program: A Report to Congress, http://www.dtic.mil/biosys/org/demil_rept2003_final.pdf accessed December 20, 2004)
Propellant	PHO0025-3	The disposal of solid rocket propellant through washing out, propelling or open burning, open detonation are some of the major sources of perchlorate contamination across the country.	Historically, the manufacturing and disposal of solid rocket propellant that contains ammonium perchlorate as an oxidizer has led to perchlorate contamination. There is no evidence to suggest that burning solid propellant in a SRM leads to emissions of perchlorate to the atmosphere. Perchlorate could be released into the environment in the form of uncombusted solid rocket propellant from a non-nominal launch or other accident causing release of solid propellant to land or water. These have been considered in the PEIS. Additional information on perchlorate has been added to the PEIS text as well as a technical appendix (Appendix M) on

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Issue Topic	Comment Number	Excerpt Text	Response
			perchlorate. This appendix considers the uses, sources, and disposal of perchlorate as well as the human health and ecological risk of exposure to perchlorate.
Propellant	PHO0037-2	Number one, exposure to increased levels of toxic pollutants from a dramatic increase in missile launches. Liquid propellants containing hydrozene, nitrogen tetroxides and other compounds that are highly toxic. In addition, ammonium perchlorate, which is used in solid propellants, it blocks the formation of key thyroid elements that are critical for growth and development, especially in fetuses and children, and this was not considered.	The impacts of accidental exposure to various propellants are discussed in Section 4.1.1.2 of the PEIS. This section of the Final PEIS has been modified to include additional information regarding the potential impacts of perchlorate. The DoD and the MDA are aware of the potential health concerns associated with perchlorate contaminated water and of the various Federal and state initiatives to address this issue. A technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS. The appendix considers the uses, sources, and disposal of perchlorate as well as the effects on human health and the environment. The DoD and the MDA are aware of the NRC study that considered thyroid function in infants including possible impacts from perchlorate exposure on birth defects and skeletal growth. Regarding birth defects resulting from non-normal thyroid function the NRC study states: *"The consequences of severe combined maternal and fetal hypothyroidism during fetal life and in newborn infants include microcephaly (small brain), mental retardation, deaf-mutism, paraplegia or quadriplegia, and movement disorders. Those abnormalities are not reversible by treatment with T4 (Foley 2000). However, the abnormalities can be largely prevented by administration of iodide to the mothers before or*

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			during the first trimester and early part of the second trimester of pregnancy (Pharoah 1993; Cao et al. 1994).” Regarding impacts to skeletal growth from non-normal thyroid function, the NRC study states: *“T4 and T3 also are required for normal skeletal development and growth. Bone cells have T3 receptors, and T3 stimulates bone formation and the appearance of the epiphyseal centers that are needed for normal growth of long bones. T3 also stimulates the production of pituitary growth hormone and insulin-like growth factor. Treatment with T4 leads to resumption of bone growth and skeletal maturation, but severely affected infants are unlikely to have normal stature.”*
Propellant	PHO0038-5	The hydrozenes that Jean mentioned were the same things that I believe came from when the space shuttle crashed and landed in Texas and there was a very large mobilization to get people not to touch those things. And if that's the same chemical that's going up with each of these launches and potentially coming back down, then those will be grave consequences indeed.	Hydrazine is one of the propellants used as part of the NASA's Space Shuttle program. Following the loss of Space Shuttle Columbia the public was requested to notify NASA as to the location of debris. Some reports stated that there was a potential for debris to be contaminated with hydrazine. However, most experts agree that there would be little to no possibility of finding hydrazine contaminated debris after an accident of this type. Hydrazine is a highly volatile substance and would not be expected to persist in an open environment for extended periods of time. The impacts to the environment from the use of hydrazine for BMDS launches are discussed in Section 4.1.1.2.

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Noise	E0431-1	An increase of 1 dB is not a doubling of sound energy. Decibel are on a quasi-logrithmic scale and it does not function like the Richter scale. An increase of 3 dB is a doubling of sound and pressure.	The commenter is correct, an increase of 3 decibels (dB) would occur as a result of doubling sound pressure. The text of the document has been modified to further clarify this and other information on noise.
Noise	E0431-2	dBA is not used to assess human reaction to a single noise event averaged over a 24-hour period. dBA is measure of sound pressure using the A-weighted scale. Many other acoustical metric are used to assess human reaction, including Leq - equivalent noise level, sound exposure level, Ldn, etc.	A-weighting is used to sum noise levels as a function of frequency to a single number, expressed in dB as A-weighted decibels (dBA). A-weighting roughly corresponds to the frequency response of the human ear. Noise metrics such as equivalent noise level (L_{eq}), Sound Exposure Level (SEL) and Day Night Average Noise Level (DNL - a 24 hour average noise level with a 10 dB nighttime noise penalty) are used to reduce noise time-history data to a single number. However, dBA can be used in conjunction with temporal noise metrics such as L_{eq}. For example, highway noise studies typically express noise levels in terms of 1 hour L_{eq}, dBA. Instantaneous sound pressure level, expressed as dBA, is typically not used to assess human annoyance. L_{eq} and DNL are typically used to assess human annoyance because these metrics have been found to correlate well with human annoyance. Many Federal agencies use DNL to assess human annoyance, yet the application of DNL to a noise environment consisting of infrequent and loud single events can be problematic. Nevertheless, extensive research has been conducted to ascertain the suitability of DNL in such noise environments. The FAA uses DNL where the noise environment of a typical airport is comprised of discrete and loud noise events. A more

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			dramatic example is the U.S. Army's use of DNL to characterize the noise environment in the vicinity of weapon firing ranges. The U.S. Army has identified various means of correcting for impulsive weapon noise by using the C-weighting scale (which does not roll off low-frequency signal content).
Generic	E0162-1	The PEIS could make a useful contribution by analyzing how to judge the effectiveness of a system with no operational requirements.	The goal of the NEPA process as established by the CEQ guidelines implementing NEPA is to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment. The CEQ does not indicate that the NEPA process itself should consider the effectiveness of the action being proposed. The MDA decision makers will base their decision about whether and how to implement the BMDS after careful consideration of the environmental analysis presented in the PEIS as well as other operational and policy considerations. It is not the role of the PEIS to determine the operational effectiveness of the proposed system only to evaluate the environmental impacts of the proposed alternatives to provide the decision makers with the information necessary to inform and support their determination.
Generic	PHO0044-7	Finally, the spiral development approach seems to preclude any meaningful assessment. The PEIS could make an useful contribution by analyzing how to judge the effectiveness of the missile defense with no specified architecture and no operational requirements.	See previous response.
Generic	E0319-22	The 1990 Clean Air Act Amendments identified 188 chemical pollutants which cause or contribute to cancer, birth defects, genetic damage, and other adverse health	The PEIS addresses the potential impacts on air quality and on health and safety resulting from the activities associated with the proposed BMDS. After reviewing

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		effects. "The PEIS has not identified any environmental health and safety risks that may disproportionately affect children, in compliance with Executive Order (EO) 13045 as amended by EO 13229" (PEIS page 4-134, Section 4.7). Executive Order 13045 of April 1997, states that each Federal agency, including the Department of Defense (as defined in 5 U.S.C.102) a. shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children, and b. shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.	the environmental analysis of these potential impacts and the potential impacts to all resource areas defined in the PEIS the MDA did not identify any environmental health and safety risks that may disproportionately affect children. The analysis of these impacts is presented in Section 4 of the PEIS.
Generic	E0347-4	There is no adequate official scientific study of the biological effects on plant, animal and the human body resulting from Fylingdales' radar emissions. Professor Dave Webb, Chair of Yorkshire Campaign for Nuclear Disarmament, has published a paper, Is it Safe?' which can be read at http://cndyorks.gn.apc.org/fdales/. Professor Webb maintains that the safety standards are inadequate and presents the evidence to substantiate his arguments. The reassuring conclusions published in the UK Ministry of Defence's 'Upgrade to RAF Fylingdales Early Warning Radar - Environment and Land Use Report are based on the inadequate safety guidelines. We endorse Prof. Webb's position and submit that his paper be considered by the US Missile Defense Agency as a	The comment has been noted and the reference has been added to the Administrative Record. The environmental impacts on biological resources and health and safety from radar activation are addressed in Section 4.1.1.3 of the PEIS and in technical Appendix N, Impacts of Radar on Wildlife. In addition to the reference mentioned by the commenter, i.e., Final Report, Upgraded Early Warning Radar, Fylingdales, UK, 7 April 2003, another official scientific study that considered Fylingdale's radar emissions is the NRC of the National Academies of Science *Assessment of Potential Health Effects from Exposure to PAVE PAWS Low-Level Phased-Array Radiofrequency Energy* published in 2005. The PEIS is a programmatic analysis; site-specific analyses would tier from this PEIS and would focus on unique aspects of these particular sites. MDA in its overseas activities has

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		contribution to public responses to the Programmatic Environmental Impact Statement.	and will comply with applicable EOs and DoD directives (see Section 4.1.3 and Appendix G). MDA has previously reviewed our activities at Fylingdales and made the appropriate determinations in compliance with applicable EOs and DoD Directives.
Generic	E0347-5	Both Fylingdales and Menwith Hill are sites of prehistoric importance known to date from the Neolithic period or earlier. Conservation of the archaeological heritage is a prime consideration in Britain and must be considered in the deliberations for the US Missile Defense Agency's Programmatic Environmental Impact Statement. The damage to these sites so far is incalculable. Herewith two examples: Menwith Hill: The Base is located on Forest Moor, an area of significance to archaeologists for its Neolithic settlement, testified by the wealth of flint microliths. The site is adjacent to an Iron-Age Brigantian Fort. The Roman Road joining the fort at Ilkley (Olicana) to the city of York (Eboracum) borders the southern boundary of the Base. The US occupants in c.1990 removed an ancient megalith known as Tibby Bilton', possibly the last standing remnant of a prehistoric group or circle of standing stones. Fylingdales (or more properly, Snod Hill): The presence of a tumulus, a group of (fallen) megaliths and petroglyphs is evidence that Snod Hill is a prehistoric funerary site.	Section 3.1.4 of the PEIS discusses why cultural resources, which include historical and archaeological concerns, are most appropriately analyzed in site-specific documentation. This section of the PEIS emphasizes that because of the unique qualities and characteristics, cultural resources should be characterized and analyzed for specific activities proposed at particular locations. The MDA has and will comply with EOs and DoD Directives applicable to MDA overseas installations and activities. (See Section 4.1.3 and Appendix G.) MDA has previously reviewed our activities at Fylingdales and made the appropriate determinations in compliance with applicable EOs and DoD Directives. If additional BMDS activities were proposed for sites such as Fylingdales, site-specific analyses including potential impacts on cultural resources would be prepared, as appropriate.

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		Snod Hill is crossed by prehistoric trackways, ancient rights of way dating from the Bronze Age or earlier, for over two thousand years in use as a 'Salt Road' from the coastal settlements. The Salt Road is notorious in later history as a route for smugglers. The Salt Road was closed peremptorily and permanently to permit the construction of the Early Warning Radar facilities.	
Generic	E0429-6, E0429-25	2. Consider in detail the management practices-launch protocols, treatment technologies, etc.-necessary to mitigate the significant environmental impacts, including increased depletion of the stratospheric ozone layer and the likely release of perchlorate into groundwater, surface water, and soil.	Because of the programmatic nature of this document it is not possible to consider specific management practices that would be imposed at specific ranges where proposed BMDS activities would occur. Appropriate guidelines and protocols are developed prior to each test and are designed to address the unique features of the test. In addition, please note that the PEIS did not identify any significant programmatic environmental impacts that require mitigation. If BMDS activities are proposed at specific locations, future analyses may reveal the potential for significant impacts which could require mitigation.
Generic	F0004-7	6 Keep it clean wherever, you go to put this all in. Clean all your toxic wastes + garbages. Kodiak Island is one of the most pristine places left on this planet...Please keep it that way - Please. Our close ocean waters are Our Living they must be kept clean + respected!	The potential environmental impacts associated with the disposal of hazardous materials and hazardous wastes and health and safety are discussed in Section 4 of the PEIS. The environmental impacts associated with specific locations such as the KLC would be discussed in site-specific environmental analyses, as appropriate.

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Issue Topic	Comment Number	Excerpt Text	Response
		Rockets + missile debrie and fish - just don't mix! And Las but NOT least...just be real damn careful out there. I love that island and want to keep it safe.	
Generic	M0267-1	Orbital debris: Testing and deployment of space-based interceptors can significantly increase space debris, endangering other objects in space, in the air and on land. We agree with the commentators from the Center for Defense Information that the PEIS does not answer sufficiently to these problems and dangers. We suspect the detrimental environmental effects are great enough in themselves to warrant cancellation of this portion of the program.	Please refer to responses to comments on orbital debris above. The MDA will announce a decision regarding the proposed activities considered in the PEIS through the issuance of a ROD.
Generic	M0267-2	Laser and kinetic kill weapons: The PEIS does not really deal with the detrimental environmental effects that will result from the process of developing, testing and deploying laser and kinetic kill weapons. Yet, these weapons are integral to the entire program. We understand there are still many problems to be solved if these science fiction fantasies are to be translated into reality. These problems and the dangers posed to the environment should be included in the PEIS. We suspect that they are great enough to warrant cancellation of the space weapons program.	The environmental impacts associated with the use of directed energy or laser weapons is considered in Section 4.1.1.1 (Weapons - Lasers) and the use of kinetic energy weapons or interceptors is considered in Section 4.1.1.2 (Weapons - Interceptors). The MDA will announce a decision regarding the proposed activities considered in the PEIS through the issuance of a ROD.
Generic	M0268-3	Hazards of use: Completely missing in this PEIS is an analysis of the hazards of use if the BMD system is ever employed. This is not a benign system, and possible hazards should be investigated. What would be the effect of a successful intercept over the Pacific Ocean or seconds after firing by another nation? What would be the extent of nuclear fall-out or the expectations of damage from an explosion of the incoming weapon? What would be the	The environmental impacts of intercepts of target missiles have been considered in Sections 4.1.2 and 4.2.2 of the PEIS. The impacts of the intercept of a threat missile launched at the U.S. by another nation would create a national security situation and perhaps lead to a war and as such would be considered outside of the scope of this NEPA analysis.

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		environmental effect of a successful intercept of a nuclear weapon over the United States, resulting in a high altitude nuclear explosion? Could electrical and communications systems across the US be destroyed? Could satellites be destroyed? Is it possible that the use of these interceptors to protect U.S. citizens could actually result in unintended destruction? Might other non-U.S. territories, in the path of the weapons, be harmed by interceptions and nuclear explosions above their areas or by debris falling onto their territory? What will be the possible effects on people and the environment on earth below if MDA war fighters actually use their weapons in space or in the skies?	
Generic	PHO0047-4	You know, I'm not sure what kind of chemical you use or you put in a missile testing or in the warhead when you intercept it in space, but all over the years that you have been doing the testing between Kwajalein and Vandenberg, has there been any environmental study of all the debris that has fallen down into the ocean to find out how contaminated the area is and how far spread the contamination is? Has there been anything done like that? And have the people been aware of what has been done or has not been done?	The PEIS considers the potential impact of debris created as a result of BMDS activities including the launch and intercept of target and interceptor missiles. In addition, previous environmental analyses produced for specific tests occurring between Kwajalein and Vandenberg AFB considered these types of site-specific issues as appropriate. Many of the references that contain these environmental analyses are available for download from the MDA PEIS web site.
Generic	PHW0002-5	The draft PEIS fails to fully address the effects of other types of debris - rocket fragments, fuel, and so forth. Again, it barely scratches the surface of potential harmful consequences that could plausibly result from the alternatives listed, and again, it immediately dismisses the few consequences that are divulged. Debris that could fall into the ocean "would become diluted and would cease to be of concern." (p. 4-51) Debris that survived reentry is not to be worried about, as it would fall into a pre-	The impacts of debris from launches of interceptors are considered for each resource area in Section 4.1.1.2. It should also be noted that, where appropriate, separate analyses are recorded for launch debris impacting on land and in water. These discussions include the potential impacts from interceptor or target hardware as well as propellants.

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Issue Topic	Comment Number	Excerpt Text	Response
		established footprint, and even if it didn't, "Debris is more likely to terminate in water than on land because water covers 75 percent of the Earth's surface." (p. 4-119) Debris from spills or intercepts in the air is assumed to dissipate before it hit the ground. (p. 4-24)	
Generic	PHW0002-6	Yet this is making a real leap of faith in how these actions would affect the environment, and doing so in a manner that precludes any real assessment of what sort of consequences could occur. The treatment of the Airborne Laser (ABL) is indicative of this attitude. The draft PEIS says that should the ABL not able to land at "an appropriate location," its fuel and laser chemicals may have to be jettisoned, but this would be at a minimum altitude of 15,000 feet and thus "would be diluted in the atmosphere." (p. 4-24) And if there was an accidental fire on the ABL, "the liquid and solid laser chemicals would be consumed or contained." (p. 4-34) These laser chemicals include hydrogen peroxide, ammonia, chlorine, helium, and iodine, according to the document, (p. 4-24) No explanation is given as to what would happen should the ABL jettison its chemicals at a lower altitude than 15,000 feet, nor how exactly the fire would contain all chemicals. The draft PEIS makes these reassuring statements with no solid evidence to back them up.	The PEIS states that the minimum altitude that laser chemicals would be jettisoned is 15,000 feet; therefore, no discussion of the potential impact of their jettison below 15,000 feet was necessary. As stated in the PEIS, in the event of an accidental fire on the ABL the laser chemicals would either be consumed in the fire or would be contained. The containment would be within the body of the aircraft and therefore the chemicals would not impact the external environment.
Generic	PHW0004-6	2. Consider in detail the management practices-launch protocols, treatment technologies, etc.-necessary to mitigate the significant environmental impacts, including increased depletion of the stratospheric ozone layer and the likely release of perchlorate into groundwater, surface water, and soil.	Because of the programmatic nature of this document it is not possible to consider specific management practices that would be imposed at specific ranges where proposed BMDS activities would occur. Appropriate guidelines and protocols are developed prior to each test and are designed to address the unique features of the test. In addition, please note that the PEIS did not identify any

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Issue Topic	Comment Number	Excerpt Text	Response
			significant programmatic environmental impacts that require mitigation. If BMDS activities are proposed at specific locations, future analyses may reveal the potential for significant impacts which could require mitigation.
Generic	PHW0004-25	2. Consider in detail the management practices-launch protocols, treatment technologies, etc.-necessary to mitigate the significant environmental impacts, including increased depletion of the stratospheric ozone layer and the likely release of perchlorate into groundwater, surface water, and soil.	See previous response.

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Accidents	F0004-4	3 When you have another accident like the one on Nov. 09, 2001 where the rocket Blew-up, Tell us the truth right away. Don't lie then tell the truth (forced as it was) 6 mos. later. Maybe if you don't try launching in 40 mph winds with snow + rain you might have a better launch window + help the process a lot...	There are inherent risks with any missile testing activity; however, protection of life and property, on and off range, is the prime concern of Range/Mission Safety personnel. The RCC Common Risk Criteria for National Test Ranges (RCC 321-02) sets the requirements for minimally acceptable risk criteria to occupational and non-occupational personnel, test facilities and non-military assets during range testing operations. Under RCC 321-02, individuals of the general public shall not be exposed to a probability of fatality greater than 1 in 10 million for any single mission and 1 in 1 million on an annual basis. Range Safety personnel also apply launch window criteria that consider various weather and climatic conditions, as appropriate.
Accidents	PHO0047-3	Or at least reassure the people that there's not going to be any accident happening. But we cannot say that there's not going to be any accident. There's no guaranty. No matter what, there's no guaranty. And if something happens, what are the people going to do?	As noted in Sections 4.1.1.1 and 4.1.1.2, Health and Safety, restricted areas are established to protect the public from launch and laser activities. These areas are established so that debris from non-nominal launches or the use of a flight termination/thrust system would not impact populated areas.
Nuclear	E0162-9	7) In addition to "hit-to-kill" interceptors and directed-energy weapons, there have been reports that interceptors armed with nuclear weapons are also being considered for missile defenses. The PEIS should indicate what research and development work is being planned for such weapons as part of the Advanced Systems in Appendix F. How would such systems be tested without violating the Limited Test Ban Treaty and the Comprehensive Test Ban Treaty?	As noted in Section 2.2.1.1, BMDS interceptors would use non-nuclear hit-to-kill or directed blast fragmentation technology to destroy a threat missile. No nuclear material will be used in any BMDS test systems. Any space-based interceptors that would be launched from a space-based platform would use propellants as indicated in the PEIS. No nuclear materials would be used to fuel the interceptors. Further, the interceptors would use non-nuclear hit-to-kill or directed blast

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			fragmentation technology to intercept and destroy a threat missile.
Nuclear	E0363-3	Finally, it would be environmentally catastrophic if these weapons were ever actually used in war. The hazards of use, including high altitude nuclear explosions, are not discussed in the PEIS but should be addressed.	See previous response.
Nuclear	E0380-2	2) The PEIS completely ignores the well known environmental impacts of radiation. It does so by maintaining the transparent fiction that an effective BMDS can be implemented without resorting to the use of nuclear war heads. Current research with BMDS prototypes provides scant basis for the belief that lasar or kinetic weapons will serve to eliminate target warheads. A realistic PEIS for BMDS must include a full and detailed consideration of the environmental impacts of nuclear weaponry. Such an assessment must address the entire nuclear cycle - production and manufacture as well as decommissioning and waste storage.	See previous response.
Nuclear	E0395-1	With respect to what the overall BMDS actually could entail, the PEIS is so broad and generalized that it is not possible to know what is covered by the overall BMDS PEIS and what isn't. For example, nuclear-tipped interceptors have been discussed by MDA officials but are not addressed in this PEIS. The extent and limitations of this PEIS should be clearly stated.	See previous response.
Nuclear	E0402-5	2) Radioactive fallout from intercepted missiles has not been considered in this PEIS. The accepted concept that a missile blown up in the outer reaches of the atmosphere is the logical conclusion of the BMDS alone should keep us	There would be no radioactive or biological material from missile intercepts during system integration testing of the proposed BMDS. Such material would not be used in any targets used for intercept and would only be

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		from deploying such a system and rather focus on truly preventative strategies that do not accept any nuclear weapon use by any country.	expected in enemy missiles which would be launched to attack the U.S. Any intercepts resulting from such an act of war upon the U.S. would not need to be considered in this PEIS, because as the commenter correctly points out the effects of war are normally excluded from analysis under NEPA.
Nuclear	E0424-2	e) The potential radioactive fallout from intercepted missiles.	See previous response.
Nuclear	E0427-17, E0439-17	16) Will any interceptors use nuclear warheads? The PEIS does not address the inability of mid- course or terminal kinetic interceptors to stop a "threat cloud" once a attack missile has MIRVed, or released many decoys or countermeasures (Richard L. Garwin. Holes in the Missile Shield. Scientific American, November 2004, page 70-79). The MDA may be temped to intercept such a threat by using large nuclear tipped interceptors. The potential use of nuclear tipped interceptors was discussed by high ranking US DOD officials in 2002. http://www.washingtonpost.com/ac2/wp-dyn/A28866-2002Apr10?language=printer. If such nuclear tipped interceptors were deployed, the environmental risks would be much greater. If so, the environmental consequences of the nuclear fallout and electromagnetic pulses from such high altitude nuclear detonations must be considered in detail. This would include analysis of risks to health and safety, contamination of water, land, soils, EMP effects on civilian and medical electrical and computer systems and infrastructure. The MDA should also consider the effects of radioactive fallout on health and safety, biological resources, and contamination of land and water resources.	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
		Furthermore, given the historic 15% missile launch failure rate, the radioactive fallout from accidents with nuclear tipped interceptors must be considered in detail. The public should have full opportunity to consider and comment on the use of such nuclear tipped interceptors in this PEIS. The point is that the blast fragmentation devices need to be described in detail to enable adequate evaluation of its environmental effects.	
Nuclear	F0005-20	(6) If interceptors armed with nuclear weapons are being considered or missile defenses, as some reports indicate, the PEIS should indicate what research and development work is being planned for such weapons as part of the Advanced Systems in Appendix F.	See previous response.
Nuclear	E0319-2	1. Whether or not any low-yield nuclear material will be used in the BMDS test systems (boosters, payloads, dummy warheads, satellites, interceptors, targets, radar systems) 2. Whether or not any low-yield nuclear material will be stored at Research Development Test Sites 3. If depleted uranium will be used in/on target missiles, interceptors, satellites, boosters, etc. 4. If depleted or spent uranium will be stored at Research, Development Test Sites	The PEIS states that interceptors may use non-nuclear lethality enhancers to increase the probability of a successful intercept. None of the components or the integrated system described in the BMDS PEIS would use nuclear material. Neither low yield nuclear material nor depleted uranium would be used in any BMDS test systems nor stored at any research and development test site.
Nuclear	E0319-19	Include in the PEIS the projected cumulative impacts from 'radiation fallout' for all space-based weapon systems (lasers, interceptors, warheads, e.g.).	There would be no radioactive or biological material from missile intercepts during system integration testing of the proposed BMDS. Such material would not be used in any targets used for intercept and would only be expected in enemy missiles which would be launched to attack the U.S. Any intercepts resulting from such an act of war upon the U.S. would not need to be considered in

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Issue Topic	Comment Number	Excerpt Text	Response
			this PEIS, because the effects of war are normally excluded from analysis under NEPA.
Nuclear	E0427-2	Note that these authors also helped to write the 2002 US Nuclear Posture review, which further solidifies the US preemptive nuclear first strike policy. Gray and Payne make it clear that BMD is essential for a more aggressive US nuclear first strike policy. Thus, there is a reasonable foreseeability that the BMDS in conjunction with US offensive nuclear forces will increase the probability of a massive nuclear war. Thus, the BMDS needs to include a detailed analysis of the environmental effects of "limited" and "all out" nuclear war, including: medical radiological, blast, burn, fallout, disease, and cancer effects to health and safety; effects on nuclear winter, as well as effects on atmosphere, global supplies of fresh water, global food supplies, and nuclear power plants and power systems. The prospect of the BMDS leading to more aggressive US policies that result in a massive nuclear war also needs to be considered in regard to a true no action alternative.	See previous response.
Nuclear	E0427-3	In short, since there is a reasonable forseeability that the BMDS in conjunction with US and Allied nuclear weapon systems and current US nuclear weapons policy as defined in the 2002 Nuclear policy review will destabilize the nuclear arms race and lead to nuclear war, the environmental consequences of nuclear war need to be considered I detail in the BMDS PEIS. (Ambio Volume XI number 2-3, 1982, Nuclear War: The Aftermath. Entire journal dedicated to the effects of nuclear war, including effects on heath and safety, Air, water resources, agriculture, biological resources, and nuclear winter.) This requested in my scoping comments was ignored, e.g.	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
		Scoping comment "#18) The MDA needs to consider whether the BMDS in conjunction with offensive first strike weapon systems and first strike policy increase the probably of a major nuclear war or other disturbance that could result in nuclear Winter, with the associated loss of species"	
Nuclear	E0439-2	Note that these authors also helped to write the 2002 US Nuclear Posture review, which further solidifies the US preemptive nuclear first strike policy. Gray and Payne make it clear that BMD is essential for a more aggressive US nuclear first strike policy. Thus, there is a reasonable foreseeability that the BMDS in conjunction with US offensive nuclear forces will increase the probability of a massive nuclear war. Thus, the BMDS needs to include a detailed analysis of the environmental effects of "limited" and "all out" nuclear war, including: medical radiological, blast, burn, fallout, disease, and cancer effects to health and safety; effects on nuclear winter, as well as effects on atmosphere, global supplies of fresh water, global food supplies, and nuclear power plants and power systems. The prospect of the BMDS leading to more aggressive US policies that result in a massive nuclear war also needs to be considered in regard to a true no action alternative.	See previous response.
Nuclear	E0439-3	In short, since there is a reasonable forseeability that the BMDS in conjunction with US and Allied nuclear weapon systems and current US nuclear weapons policy as defined in the 2002 Nuclear policy review will destabilize the nuclear arms race and lead to nuclear war, the environmental consequences of nuclear war need to be considered in detail in the BMDS PEIS. (Ambio Volume XI number 2-3, 1982, Nuclear War: The Aftermath.	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
		Entire journal dedicated to the effects of nuclear war, including effects on heath and safety. Air, water resources, agriculture, biological resources, and nuclear winter.) This request in my scoping comments was ignored, e.g. Scoping comment "#18) The MDA needs to consider whether the BMDS in conjunction with offensive first strike weapon systems and first strike policy increase the probably of a major nuclear war or other disturbance that could result in nuclear Winter, with the associated loss of species"	
Nuclear	PHO0011-5	Also, will the space-based satellites use nuclear power sources? Will any BMDS interceptors use nuclear warheads? This was not clearly defined. This is unsatisfactory.	See previous response.
Nuclear	PHO0050-1	For example, I read all of the material out there. I don't even see the word "depleted uranium."	None of the components or the integrated system described in the BMDS PEIS would use nuclear material. Neither low yield nuclear material nor depleted uranium would be used in any BMDS test systems nor stored at any research and development test site.
Nuclear	E0319-8	The MDA has never referenced or included discussion on the INF Treaty MOU in any previous EA or EIS in regard to missile defense testing, nor is it discussed in the BMDS Draft PEIS. Why not? Why is the MDA avoiding this issue? Nor has the MDA referred to or listed the Research and Development test site locations in Alaska on the INF Treaty MOU list (e.g. Kodiak Launch Complex, Alaska and Poker Flats Rocket Range, Alaska). The MDA's avoidance of discussion on these test launch sites, leaves open the question as to whether or not nuclear material can and will be launched from these test-site locations on future targets, interceptors, boosters, dummy warheads or	Once plans for launching targets are sufficiently detailed, the plans are reviewed for compliance with all applicable arms control treaties, including the Intermediate-Range Nuclear Forces (INF) and Reduction and limitation of Strategic Offensive Arms Treaty (START) Treaties, if appropriate. Because it is the policy of the DoD to ensure that all DoD activities comply fully with U.S. arms control agreements, no activities will be conducted that would violate any such agreement. The PEIS considers international treaties and law in conjunction with EO 12114, Environmental Effects Abroad of Major Federal Actions.

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Issue Topic	Comment Number	Excerpt Text	Response
		used in laser systems. The PEIS should include information on the INF Treaty, the INF Treaty MOU test locations, plus any proposed future plans to use nuclear material as part of ground-based or space-based BMDS testing. The MDA is projecting test plans up to the year 2014, so it already knows if nuclear material is part of the BMDS test system (power for space-based platforms, lasers, etc).	As noted in Section 2.2.1.1, BMDS interceptors would use non-nuclear hit-to-kill or directed blast fragmentation technology to destroy a threat missile. Neither low yield nuclear material nor depleted uranium would be used in any BMDS test systems nor stored at any research and development test site.
Nuclear	E0387-5	Further to this, plans for weapons such as the space-based laser may eventually incorporate the use of nuclear power. The deployment of nuclear powered satellites could be environmentally disastrous with considerable risk of high-level pollution at the point of initial launch, when in orbit (from attack or accident) and (if and when the orbit decays) during re-entry into the Earth's atmosphere	The space-based weapons platform described in Alternative 2 of the BMDS PEIS does not include the use of lasers or the use of nuclear power sources for the weapons platform. If the proposed design of the space-based weapons platform changed, the MDA would prepare additional environmental analyses, as appropriate.
Nuclear	E0395-10	The use of radioactive sources on missile defense satellites, either for surveillance, target tracking and target discrimination, or on space-based missile defense interceptors is not discussed.	As noted in Section 2.2.1.1, BMDS interceptors would use non-nuclear hit-to-kill or directed blast fragmentation technology to destroy a threat missile. No nuclear material will be used in any BMDS test systems. The space-based platforms for weapons and sensors described in the BMDS PEIS do not include the use of radioactive materials. If the proposed design of these space-based platforms changed, the MDA would prepare additional environmental analyses, as appropriate.
Nuclear	PHO0011-7	Also, the PEIS, has not considered any -- has not considered any radioactive follow-up from interceptive missiles.	There would be no radioactive or biological material from missile intercepts during system integration testing of the proposed BMDS. Such material would not be used in any targets used for intercept and would only be expected in enemy missiles which would be launched to attack the U.S. Any intercepts resulting from such an act

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Issue Topic	Comment Number	Excerpt Text	Response
			of war upon the U.S. would not need to be considered in this PEIS, because the effects of war are normally excluded from analysis under NEPA.
Nuclear	PHO0037-5	Six, radioactive fallout from intercepted missiles has not been considered. The effects of war are normally excluded from analysis by NEPA; however, this proposed BMDS action is very likely to provoke a worldwide WMD arms race and force other nations to prepare to launch a massive retaliation against the U.S. should war ensue. And I believe that radioactive fallout needs to be looked at and not written off as a no significant impact.	See previous response.
Treaties	E0162-4	2) The PEIS should examine in detail treaty compliance of various BMDS tests. The draft PEIS has no discussion of INF Treaty restrictions on long-range air-launched and sea-launched targets or START Treaty restrictions on sea-launched targets even though I raised this issue in my scoping comments. (See fourth comment on page B-15.) The GMD ETR EIS did not consider treaty compliance despite the fact that previous analyses (1994 TMD ETR EIS and 1998 TMD ETR Draft Supplemental EIS) did consider this issue. The 1994 TMD ETR EIS refers to the INF treaty prohibition of air-launched and sea-launched missiles with ranges between 500 and 5,500 kilometers. The 1998 TMD ETR DSEIS notes that the START treaty prohibits launches from sea-based platforms and that launches from ships are restricted to ranges less than 600 kilometers. If subsequent compliance reviews of air-launched and sea-launched targets have been done, they should be discussed in the PEIS and references to them should be cited. I was assured at the 26 Oct. meeting in Honolulu that this would be considered.	Once plans for launching targets are sufficiently detailed, the plans are reviewed for compliance with all applicable arms control treaties, including the INF and START Treaties if appropriate. Because it is the policy of the DoD to ensure that all DoD activities comply fully with U.S. arms control agreements, no activities will be conducted that would violate any such agreement. The PEIS considers international treaties and law in conjunction with EO 12114, Environmental Effects Abroad of Major Federal Actions.

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Issue Topic	Comment Number	Excerpt Text	Response
Treaties	F0005-16	(2) The draft PEIS contains no discussion of INF Treaty restrictions on long-range air-launched and sea-launched targets, or START Treaty restrictions on sea-launched targets. Accordingly, the PEIS should examine in detail treaty compliance of various BMDS tests.	Launches of air-launched and sea-launched targets would be reviewed for compliance with all applicable arms control treaties, including the INF and START Treaties as appropriate. Because it is the policy of the DoD to ensure that all DoD activities comply fully with U.S. arms control agreements, the MDA would conduct no testing activities that would violate any such agreements.
Treaties	E0319-8	The MDA has never referenced or included discussion on the INF Treaty MOU in any previous EA or EIS in regard to missile defense testing, nor is it discussed in the BMDS Draft PEIS. Why not? Why is the MDA avoiding this issue? Nor has the MDA referred to or listed the Research and Development test site locations in Alaska on the INF Treaty MOU list (e.g. Kodiak Launch Complex, Alaska and Poker Flats Rocket Range, Alaska). The MDA's avoidance of discussion on these test launch sites, leaves open the question as to whether or not nuclear material can and will be launched from these test-site locations on future targets, interceptors, boosters, dummy warheads or used in laser systems. The PEIS should include information on the INF Treaty, the INF Treaty MOU test locations, plus any proposed future plans to use nuclear material as part of ground-based or space-based BMDS testing. The MDA is projecting test plans up to the year 2014, so it already knows if nuclear material is part of the BMDS test system (power for space-based platforms, lasers, etc).	The proposed BMDS would use hit-to-kill or directed fragmentation intercept technologies or directed energy weapons to destroy threat missiles. No nuclear materials are proposed for use with the system. Testing of BMDS components would be reviewed for compliance with all applicable arms control treaties, including the INF and START Treaties as appropriate. Because it is the policy of the DoD to ensure that all DoD activities comply fully with U.S. arms control agreements, the MDA would conduct no testing activities that would violate any such agreement.
Treaties	PHO0044-1	There's no examination of treaty restriction on target launches in this EIS, no quantitative information on the liabilities of rocket boosters.	BMDS flight testing is carried out in conformance with all applicable treaties and international agreements. It is not clear what liabilities of rocket boosters the commenter is referring to. All tests receive thorough

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Issue Topic	Comment Number	Excerpt Text	Response
			safety and risk evaluations at the relevant range/test facility from which any test launches are scheduled to occur. This includes flight trajectory and debris impact hazard zone in the event of a non-nominal launch.
Treaties	PHO0046-5	So the Programmatic EIS fails to analyze how the proposed BMDS system will affect the international security environment, how will it impact international laws and treaties such as prohibitions on the weaponization of space. And that's one of the explicit options for the Ballistic Missile Defense System. So that goes against established agreements to keep space for peace.	The PEIS considers the potential environmental impacts of feasible options for proposed BMDS systems implementation including the placement of interceptors in space. The MDA conducts all testing in accordance with all applicable treaties and international agreements.

Exhibit K-5. Response to Comments – Proposed Action and Alternatives

Issue Topic	Comment Number	Excerpt Text	Response
Alternatives	E0395-7	Historically, missile defenses have been divided between battlefield-theater defense and strategic defense. All previous administrations kept these two aspects of missile defenses segregated. A fourth alternative could be to develop and integrate theater defenses while postponing defenses to strategic attack.	As noted in Sections 1.4 and 2.6, MDA has evaluated the threat environment and concluded that an effective missile defense should include defense against ballistic missiles in all phases of flight and components based at least on air, sea, and land to meet the threat. Alternatives that provide only one platform or do not address all phases of flight under the current threat would reduce the capability of BMDS to defend the U.S., its deployed forces, allies, or assets from a ballistic missile attack. The proposed alternatives necessarily include a theater or regional defense as the BMDS would better defend against an attack in all phases of flight, not just the terminal phase of the attack. In addition, the U.S. cannot discontinue activities being considered for integration into the BMDS. This would decimate some of the basic defense systems of the U.S. In situations where the proposed action is to integrate existing programs, the no action alternative would be to not integrate the existing programs.
Alternatives	E0427-22, E0439-22	21) Alternative 3: Not developing, or building the BMDS or any of its components and instead renegotating an expanded and verifiable ABM / BMDS treaty: The ABM treaty helped to stabilize and de-escalate the nuclear arms race for all of its 29 years of existence. No country dared attack the US with nuclear missiles, in part because the U.S. would know exactly where the missile came from and have the clear ability to retaliate and bomb them into obivilion. That is certainly still the case. This option would preserve deterrence and peace. Yet it would enable	See previous response.

Exhibit K-5. Response to Comments – Proposed Action and Alternatives

Issue Topic	Comment Number	Excerpt Text	Response
		the nuclear nations to abide by the NPT and reduce the overall level of nuclear weapons, in exchange for non-nuclear nations not developing nuclear weapons.	
Alternatives	PHO0023-2	And in addition, theater defenses have a realistic success because the boost phase of a missile is relatively slow and even the descent of a short-range, medium-range missile is much slower than that of the strategic missile, which could be traveling at 10 kilometers per second, which makes it very unlikely to hit. The alternative, it may be politically impossible for you to do this, but I think you should try to have another alternative which would simply be to keep the -- this is probably the presidential candidate John Kerry's position on these matters -- would be to move ahead on theater defenses but to maintain the strategic weapons that the missile defense is -- against long-range missiles to be held in research and development stage. And -- and that would be my suggestion for a true alternative.	See previous response.
Alternatives	E0427-23, E0439-23	22) Alternative 4: Preserving Space for non-military purposes. The MDA should consider the alternative of not militarizing space. The planned US militarization and domination of space as described in the US Space Command Vision for 2020 (http://www.fas.org/spp/military/docops/usspac/lrp/ch02.htm) and as described in the 2002 US defense guidance policy and elsewhere, will certainly create and intensify conflicts over the control of space for years to come. These US policy documents talk about "Full Spectrum Domination", "negating" or "destroying" the enemy's satellites and use of space. As US citizens we would like for the US to protect space from militarization, but do we	The MDA has carefully reviewed and considered all alternatives provided as part of the scoping and public review process for the BMDS PEIS. Please note that Alternative 1 considers the implementation of the BMDS without the use of space-based weapons. Thus, an alternative that does not include the use of weapons in space has been considered in the PEIS. The DoD relies on the use of space-based assets for communication and data collection for a variety of programs include missile defense activities. The DoD has many assets such as satellites already deployed in space. It would not be a reasonable alternative for the DoD to stop using these

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Issue Topic	Comment Number	Excerpt Text	Response
		want the US to dominate space, and to start a series of space wars? Think about how you would feel if you lived in another nation and some one destroyed your satellites. Would such actions be considered an act of war? Additionally how does the BMDS PEIS affect US compliance with the Outer Space Treaty?	military assets. Therefore, the recommended alternative will not be considered as suggested.
Alternatives	E0427-24, E0439-24	23) Alternative 5: Deployment of a much more limited land and or Sea based theatre BMD that would offer protection from attack by short or intermediate range missiles. For example, rather than develop the extensive land, Sea, air and space based system, the US and its allies could instead deploy a currently available Aegis missile cruiser(s) off of North Korea. Such a small, affordable, alternative system would immediately meet the needs of defending Japan against missiles that might be launched by North Korea without invoking fears that it would be used to enable invasions and/or domination of the world and thereby starting a massive global arms race.	An alternative similar to that suggested by the commenter was considered in Section 2.6.2 of the BMDS PEIS. The MDA determined that alternatives that provide only one or two platforms would reduce the capability of the BMDS to defend against an attack and would not provide an integrated layered defense that could have multiple opportunities to destroy a threat missile. Therefore, alternatives that provide for a BMDS using only one or two platforms were not considered further in the PEIS.
Alternatives	F0005-6	In addition, the purpose of the proposed action also influences how the "no action" alternative should be presented. When the purpose is narrow, encompassing distinct federal action on a new project, the "no action" alternative must address the environmental effects of the action not going forward, including the effects of any probable outcomes that will occur without the project. (Forty Most Asked Questions, 46 F.R. 18026, at Answer 3.) Alternatively, when the project is broad, encompassing the next phase of federal action in a continuing project, as here, the "No action" alternative must consider the effects of "no change" from the present course of action. (See also	The PEIS considered the effects of no action as no change from the status quo of developing and testing individual systems versus the integration and integrated testing of the system.

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Issue Topic	Comment Number	Excerpt Text	Response
		American Rivers v. Federal Energy Regulatory Commission, 201 F. 3d 1186, 1201; 9th Cir. 1999).	
Alternatives	F0005-7	Here, MDA's interpretation of the proposed project purpose and need is internally inconsistent - in one case narrow, in the other broad. The MDA chooses its alternatives based on the narrow purpose of developing an integrated, multi-layered BMDS while its "no action" alternative allowing for continued research and testing of a non-integrated BMDS, implying that the project supports the general purpose of protecting the United States from foreign missile attacks through any means necessary. (PEIS at pp. 1-1 to 1-8, describing the general history of the government's ongoing development of ballistic missile defense programs.) Consequently, in the PEIS, the MDA sets out two internally contradictory positions. On the one hand, the MDA narrows the purpose of the proposed action, and thus the spectrum of alternatives to be considered, to the creation of a singular, integrated; multi-layered BMDS that is not part of a continuing program to protect the U.S. from ballistic missile attacks. On the other hand, the agency relies on the long history of the U.S.'s missile defense actions to frame its "no action" alternative as a "no change" in an ongoing project with the broad purpose of protecting the U.S. from ballistic missile attacks. On either ground, the PEIS fails to meet the NEPA test - that it interprets its purpose too narrowly in order to develop a very narrow spectrum of alternatives, or that it interprets the purpose too broadly in order to assert a "no action" alternative that allows for continuing, non-integrated action - but not both.	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
Alternatives	F0005-8	In determining whether the alternatives analyzed within an EIS are adequate, courts have determined that the range of alternatives an agency must consider, although not "self-defining," is "bounded by some notion of feasibility." (Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 551 (1978). Accordingly, the alternatives examined by an agency must include only those that are reasonable and feasible - i.e., that are "meaningly possible". However, reasonableness is determined through a fact-specific examination of each proposed project because "what constitutes a reasonable range of alternatives depends upon the nature of the proposal and the facts in each case. A flaw in the PEIS is that the range of alternatives considered by the MDA is not adequate, because the agency unreasonably narrowed the range of alternatives to be examined by narrowly interpreting the purpose of the proposed action as the development of a multi-layered ballistic missile defense system. While courts typically afford agencies some discretion in defining the purpose and need of a proposed project, that discretion is limited by the reasonableness of the agency-defined purpose and need. It is also clear that an agency may not characterize its proposed action purpose so narrowly as to avoid its NEPA obligations (See Friends of Southeast's Future v. Morrison, 153 F.3d 059, 1066; 9th Cir. 1998, and Simmons v. U.S. Army Corps of Engineer 120 F 3d 664, 669-670; 7th Cir. 1997). It seems to LAWS that is exactly what the MDA has done here. We doubt that a reviewing court would condone it, or find that when an agency varies	The purpose and need as described in the BMDS PEIS is reasonably drawn to fulfill national security goals and interests as directed by the Congress, the President and the Secretary of Defense. The goal is to successfully defend the U.S., its deployed forces, allies or assets from a ballistic missile attack. MDA has evaluated the threat environment (e.g., potential launch locations, missile flight paths, and target locations) and concluded that an effective missile defense should include components based on at least the land, sea, and air to provide an adequate defense. To meet this goal, the PEIS presents and analyzes reasonable alternatives, which would provide the nation with a BMDS capability to meet any attack in a successful and timely fashion. Alternatives that do not include the means of accomplishing the goals achieved by an effective missile defense would not be reasonable alternatives. The No Action Alternative presented in the BMDS PEIS is appropriate because the proposed action seeks to change the existing missile defense program to meet current threats. In cases where the Federal agency seeks to change existing programs, the appropriate No Action Alternative is to continue the agency's present course of action. Proposals for a No Action Alternatives, which would involve canceling the development of all ballistic missile defense capability development and testing, would eliminate the capability to defend the U.S., its deployed forces, allies, or assets from a ballistic missile attack (should other deterrents fail), and would not provide the means of meeting the purpose of or need for

Exhibit K-5. Response to Comments – Proposed Action and Alternatives

Issue Topic	Comment Number	Excerpt Text	Response
		its interpretation in order to avoid its NEPA responsibilities, the PEIS can be found to meet the NEPA standard.	the proposed action as described in Section 1 of the PEIS.
Alternatives	F0005-9	In this connection, the spectrum of alternatives to be considered must be broader than those considered by the MDA. (See Morton, 458 F.2d at 837) Accordingly, a court could find that consistent with its obligations under NEPA that the MDA should have considered as an alternative the Theater Missile Defense System which has already been developed and, therefore, would not require excessive resources to implement. The MDA should also have considered, and included in the PEIS, alternatives that offer a less than complete solution to the problem. To the extent that it hasn't, the MDA should also have analyzed the BMDS platforms for each component and/or defense environment separately. Other options include an analysis of alternatives that include both weapon and non-weapon components, such as integration of land and sea-based platforms only with increased diplomatic efforts. As the Court said in Morton, an agency cannot restrict its alternatives because it is not part of its jurisdiction. Since the BMDS is part of a broader purpose of protecting the U.S., the MDA should have fulfilled its NEPA obligations by analyzing a much broader spectrum of alternatives to achieve this purpose.	As noted in Sections 1.4 and 2.6, MDA has evaluated the threat environment and concluded that an effective missile defense should include defense against ballistic missiles in all phases of flight and that an effective missile defense should include components based at least on air, sea, and land to meet the threat. Alternatives that provide only one platform or do not address all phases of flight under the current threat would reduce the capability of BMDS to defend the U.S., its deployed forces, allies, or assets from a ballistic missile attack. The proposed alternatives necessarily include a theater or regional defense as the BMDS would better defend against an attack in all phases of flight, not just the terminal phase of the attack. In addition, the previous NEPA analyses considering Theater Missile Defense and NMD were incorporated by reference into this PEIS. However, theater and regional defense were not considered sufficient to meet the purposes of an integrated BMDS and were not reconsidered in this PEIS.
Alternatives	M0046-1	This Alternative 4 would include a return to the United Nations disarmament treaty process (which the current Administration is regrettably blocking), and assumption of a lead role in the continual development of enforceable and universally applied international law consistent with	The MDA has carefully reviewed and considered all alternatives provided as part of the scoping and public review process for the BMDS PEIS. In this instance it was determined that the proposed alternative would not meet the purpose and need for the proposed action as

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		both the UN Charter and the Universal Declaration of Human Rights. The United States would re-enter that process as the most powerful and most militarized nation in the world and would have no substantial military rivals. This is a rare and critical moment in history and the choice is ours: the United States can lead the way toward a world freed from war with sustainable development and human rights for all - or this nation can drag the human race backward with it into a world ruled by war, military domination and the threat (or use) of weapons more powerful than any known before.	described in Sections 1.3 and 1.4 and does not meet the direction of the President and the U.S. Congress. The BMDS would have the capability of defending the U.S. against an attack for which there was no prior warning, such as advance notification of an armed enemy inter-continental ballistic missile (ICBM) on a launch pad.
Alternatives	PHO0014-1	The alternative of a diplomacy-based defense system is not considered. In fact, diplomacy seems to be a -- a foreign concept to the current Administration.	See previous response.
Alternatives	PHW0008-1	This Alternative 4 would include a return to the United Nations disarmament treaty process (which the current Administration is regrettably blocking), and assumption of a lead role in the continual development of enforceable and universally applied international law consistent with both the UN Charter and the Universal Declaration of Human Rights. The United States would re-enter that process as the most powerful and most militarized nation in the world and would have no substantial military rivals. This is a rare and critical moment in history and the choice is ours: the United States can lead the way toward a world freed from war with sustainable development and human rights for all - or this nation can drag the human race backward with it into a world ruled by war, military domination and the threat (or use) of weapons more powerful than any known before.	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
Alternatives	PHO0048-4	But, in addition, you'll notice from reading the two alternatives, they're simply variations on a theme, they're one and the same thing.	The alternatives include very different weapons basing platforms and ultimate capabilities. To provide the requisite multi-layered defensive system, land-, sea-, and air-based platforms were considered with the real alternative of adding space-based weapons platforms. The alternatives are very different and involve different requirements for implementation and testing.
Alternatives	PHW0001-3	One alternative not even mentioned in the PEIS would be to cut the spending in half, to allow the testing of a system to determine if it would eventually work against potential adversaries such as North Korea or Iran.	Budget-based alternatives are not appropriately considered in this PEIS as the Congress deliberates and passes the budgetary specifications for the Department of Defense (DoD), specifically including the MDA.
Alternatives	PHW0001-4	Another would be to look at the realistic likelihood that if the US is ever confronted by a nation such as North Korea or Iran with a tested ICBM with a likely nuclear warhead, the option of military necessity would be to destroy such an enemy ICBM on its launchpad with precision-guided missiles if an attack seemed imminent.	The MDA has carefully reviewed and considered all alternatives provided as part of the scoping and public review process for the BMDS PEIS. In this instance it was determined that the proposed alternative is not "reasonable" as intended in NEPA and therefore, the suggested alternative is not considered in the BMDS PEIS. The BMDS would have the capability of defending the U.S. against an attack for which there was no prior warning, such as advance notification of an armed enemy ICBM on a launch pad.
Alternatives	PHW0002-8	Finally, the alternatives considered but not carried forward are deliberately chosen to showcase the BMDS systems that the Bush administration has been pushing for in the best light possible. The first one is to cancel development of BMD capabilities, which is explained as being an alternative that "would rely upon diplomatic and military measures to deter missile threats against the U.S." (p. 2-68) This is exactly what has kept the United States safe from attack to date, and yet it is summarily dismissed out of hand. The other alternative is to focus on a single- or	Increasingly the reliance upon diplomatic and military measures to deter threats against the U.S. has been seen as ineffective without a working defensive system against threat missile attack. The U.S. can be attacked with loss of life and property given the admission of North Korea that they have nuclear weapons and the effectiveness of a BMDS can only serve to augment the effectiveness of military deterrence against such an attack.

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		two-platform BMDS. But, per MDA threat assessments that are not given but merely referred to, it has decided that "an effective missile defense should include components based on at least the land, sea, and air," so a more limited missile defense system simply would not do. (p. 2-68)	
NEPA Process	E0427-25	Thus, a non-proliferation analysis is needed for the BMDS PEIS particularly in regard to a genuine no action alternative.	The DOE review was critical because it involved the use of nuclear power, which is not an issue associated with the proposed BMDS. The proposed BMDS as described in the PEIS does not include the use of nuclear materials; therefore, the environmental impacts of use, storage, or transfer of nuclear material are not discussed in this PEIS. A non-proliferation analysis is not within the scope of the PEIS analysis of the environmental consequences of the BMDS.
NEPA Process	E0427-26	A mainly political justification was also given on BMDS PEIS pages 1-14 for not considering scoping comments showing "concern that the BMDS would create an arms race, especially in space" comments showing "opposition to the development of nuclear weapons and concern that missile defense could be a first strike capability for U.S. worldwide military domination". Specifically, the MDA PEIS stated the rationale for excluding these comments is that "Public comments concerning DoD policy, budget and program issues are outside the scope of the Draft BMDS PEIS". These political justifications used by the MDA are insufficient for excluding these and related issues of non-proliferation from analysis in the BMDS PEIS. A non-proliferation analysis is needed for the BMDS. We all	See previous response.

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		want to be safe from missile attack. The non-proliferation analysis is needed to determine if the BMDS is likely to ultimately increase our security, and maintaining environmental quality or result in an out of control arms race that decreases our security and wreaks wide spread environmental destruction. Because of the reasonable foreseeability of increased potential for environmental harm due to proliferation and security risks, I strongly recommend that the MDA prepare a detailed Nonproliferation Impact Review for the BMDS PEIS including a Nonproliferation Impact Review EIS for each BMD component and for each BMD site or location. These reviews will determine the scope and need for a MDA high-level program and the alternative that would cause the least environmental harm. If the BMDS is the best alternative for such a program, these review processes will thoroughly assess the potential proliferation, security and environmental harms and ways to mitigate those potential harms. This will mean that proactive plans to protect the environment, public safety and national security will be developed in advance rather than in response to a problem, accident or crisis.	
NEPA Process	E0427-27	The DOE has set an important precedent by conducting a Programmatic EIS, including a Nonproliferation Impact Review (NIR), for its Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, including the Role of the Fast Flux Test Facility in December 2000 and for its Stockpile Stewardship and Management in September 1996. Furthermore, Nonproliferation Analyses were conducted	See previous response.

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		in the following DOE EIS or Site-Wide EIS review documents: Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling (October 1995); Section 1.5.6 Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel, Page 1-10. Final Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site(August 1998); Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor (March 1999).): 1.3.5 Nonproliferation, Page 1-9 and 1-10. Final Site-Wide Environmental Impact Statement for the Y-12 National Security Complex (September 2001): Section 2.2.3 Nonproliferation and National Security, Page 2-7. Following this precedent, the MDA BMDS, in my opinion, necessitates an equally comprehensive review. Such a Nonproliferation Review Should Include Public Hearing, Scoping and Comment.	
NEPA Process	E0427-28	25) I highly recommend that the Nonproliferation Impact Review be conducted like the NEPA process that includes public participation in the scoping phase and a draft	See previous response.

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		document circulated for public comment. This open process is critical because intent really is the biggest differentiating factor between defensive and offensive military research. The participation of individual citizens who live near the proposed facility and have personal concerns such as health and property values, as well as representatives from professional and nonprofit groups who specialize in public health, emergency response, sewage treatment, landfills, water, environment, toxicology, science, medicine and arms control may identify unforseen problems, more cost-effective solutions and new ways to open up the process while maintaining necessary security. This scrutiny and public debate can only improve the quality of the decision-making process and will likely result in more confidence in the final decision on the part of those most directly impacted.	
NEPA Process	E0439-25	Thus, a non-proliferation analysis is needed for the BMDS PEIS particularly in regard to a genuine no action alternative.	See previous response.
NEPA Process	E0439-26	A mainly political justification was also given on BMDS PEIS pages 1-14 for not considering scoping comments showing "concern that the BMDS would create an arms race, especially in space" comments showing "opposition to the development of nuclear weapons and concern that missile defense could be a first strike capability for U.S. worldwide military domination". Specifically, the MDA PEIS stated the rationale for excluding these comments is that "Public comments concerning DoD policy, budget and program issues are outside the scope of the Draft BMDS PEIS".	See previous response.

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		These political justifications used by the MDA are insufficient for excluding these and related issues of non-proliferation from analysis in the BMDS PEIS. A non-proliferation analysis is needed for the BMDS. We all want to be safe from missile attack. The non-proliferation analysis is needed to determine if the BMDS is likely to ultimately increase our security, and maintaining environmental quality or result in an out of control arms race that decreases our security and wreaks wide spread environmental destruction. Because of the reasonable foreseeability of increased potential for environmental harm due to proliferation and security risks, I strongly recommend that the MDA prepare a detailed Nonproliferation Impact Review for the BMDS PEIS including a Nonproliferation Impact Review EIS for each BMD component and for each BMD site or location. These reviews will determine the scope and need for a MDA high-level program and the alternative that would cause the least environmental harm. If the BMDS is the best alternative for such a program, these review processes will thoroughly assess the potential proliferation, security and environmental harms and ways to mitigate those potential harms. This will mean that proactive plans to protect the environment, public safety and national security will be developed in advance rather than in response to a problem, accident or crisis.	
NEPA Process	E0439-27	The DOE has set an important precedent by conducting a Programmatic E1S, including a Nonproliferation Impact Review (NIR), for its Civilian Nuclear Energy Research and Development and Isotope Production Missions in the	See previous response.

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		United States, including the Role of the Fast Flux Test Facility in December 2000 and for its Stockpile Stewardship and Management in September 1996. Furthermore, Nonproliferation Analyses were conducted in the following DOE EIS or Site-Wide EIS review documents: Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling (October 1995); Section 1.5.6 Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel, Page 1-10. Final Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site(August 1998); Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor (March 1999).): 1.3.5 Nonproliferation, Page 1-9 and 1-10. Final Site-Wide Environmental Impact Statement for the Y-12 National Security __Complex_ (September 2001): Section 2.2.3 Nonproliferation and National Security, Page 2-7. Following this precedent, the MDA BMDS, in my opinion, necessitates an equally comprehensive review. Such a Nonproliferation Review Should Include Public Hearing, Scoping and Comment.	

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NEPA Process	E0439-28	25) I highly recommend that the Nonproliferation Impact Review be conducted like the NEPA process that includes public participation in the scoping phase and a draft document circulated for public comment. This open process is critical because intent really is the biggest differentiating factor between defensive and offensive military research. The participation of individual citizens who live near the proposed facility and have personal concerns such as health and property values, as well as representatives from professional and nonprofit groups who specialize in public health, emergency response, sewage treatment, landfills, water, environment, toxicology, science, medicine and arms control may identify unforseen problems, more cost-effective solutions and new ways to open up the process while maintaining necessary security. This scrutiny and public debate can only improve the quality of the decision-making process and will likely result in more confidence in the final decision on the part of those most directly impacted.	See previous response.
NEPA Process	F0003-3, M0276-3	c. As suggested by CEQ regulations, MDA has taken advantage of the extensive environmental analyses that already exist for many of the existing components of the proposed BMDS by incorporating these materials into the DPEIS by reference. However, some of these documents are greater than 10 years old. The PEIS should confirm the validity of the information in these documents.	In accordance with 40 CFR § 1502.21, Incorporation by Reference, information that was incorporated by reference in the PEIS has been cited and briefly described in the PEIS and made available during the public review period. The MDA has reviewed the portions of the information from these documents that are incorporated by reference and found them to be valid and relevant to this PEIS.
NEPA Process	F0005-1	For example, Section 1.2 shows that environmental analyses have already been completed for most components, the notable exceptions feeing the Aegis BMD and spacebased weapons. As we understand it,	This PEIS is being prepared to address the potential impacts of alternatives for implementing the proposed BMDS. As described in Section 2.1.3 of the PEIS, the system acquisition process historically has focused on

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		development and testing of most components are well underway and decisions about initial deployment of GBI's and Aegis BMD ships have been made.	the development of independent stand-alone defensive elements. Consistent with this approach, the MDA developed NEPA analyses that appropriately considered the impacts of these stand-alone systems. The MDA is now working to incrementally develop and field a BMDS that layers and integrates defenses to intercept ballistic missiles in all ranges of flight. Therefore, it is now appropriate for the MDA to prepare a PEIS which discusses the environmental impacts of the proposed system as a whole. Future site-specific analyses necessary to support proposes tests or new developments of the BMDS will tier from this PEIS, as appropriate. Therefore, the PEIS is being developed as intended under NEPA as a resource to help MDA decision makers determine the environmental impacts of implementing the BMDS as an integrated system.
NEPA Process	F0005-2	Morever, the spiral development process, which is described on page ES-7 of the PEIS, allows MDA to "consider deployment of a missile defense system that has no specified final architecture and no set of operational requirements." Such a process is apparently intended to preclude any meaningful assessment, and thus far it has succeeded brilliantly, to the detriment of the public interest, the national defense of the United States, and in frustration of the purpose of requiring careful NEPA analysis of major federal actions.	While the Executive Summary does provide a brief summary of the "spiral development process" Section 2.1.3 of the PEIS provides a more detailed look at the MDA's current acquisition approach. This approach allows the MDA to be more flexible in adapting to emerging threats leading to a more successful defensive system. This approach is not intended to nor does it "preclude any meaningful assessment" of the system or its environmental impacts. The MDA will continue to inform and involve the public in the NEPA process for future tiered analyses that are applicable to the BMDS.
NEPA Process	F0006-2	Based on the information provided in the draft PEIS, NOAA Fisheries recommends that the Missile Defense Agency consult with the appropriate NOAA Fisheries Regional Office to determine if listed species under the	On January 14, 2004 MDA representatives met with NOAA Fisheries Service personnel to discuss programmatic consultation pertaining to the BMDS PEIS. If site-specific analyses indicate that BMDS

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		Endangered Species Act (ESA) of 1973 as amended (16.U.S.C. 1531 et. seq.) may be affected by the proposed project. If it is determined that this project may affect a listed or proposed species, the Missile Defense Agency should request initiation of consultation with NOAA Fisheries pursuant to section 7 of the ESA.	activities may affect species listed under the Endangered Species Act of 1973, the MDA will request consultation with the relevant NOAA Fisheries Service Regional Office, as appropriate.
NEPA Process	PHO0011-8	The effects of war are not excluded for the analysis of NEPA.	The interceptors would only be launched in defense of the nation in the event of a ballistic missile attack. The environmental impacts of wartime operations are highly speculative and are not susceptible to meaningful analysis in an EIS. In addition, the effects of war are excluded from analysis under NEPA.
NEPA Process	PHO0048-8	They are using this process to sort of tell people who don't think we have the time to get involved because we're too busy being employed and trying to raise a family, they use this process to cover up the fact that we aren't really making an informed decision, that people are being taken advantage of, and the law is being tweaked and used to their advantage to disempower us. So although they may meet technical requirements of NEPA, we need to make people aware of the fact that they are not meeting the real requirements of NEPA and we aren't making an informed decision. Thank you.	The MDA has made extensive efforts to ensure that the public had adequate opportunity to review and comment on this PEIS. In addition to the public hearings, the MDA developed a publicly accessible web site to provide information on the BMDS PEIS and request comments on the Draft PEIS. The MDA also established toll-free phone and fax lines, an e-mail address, and a U.S. postal service mailbox for submittal of comments and questions. Both the Notice of Availability (NOA) of the Draft PEIS published in the Federal Register (FR) and the BMDS PEIS web site provided instructions on submitting comments on the Draft PEIS. Comments received via any of the methods identified carry exactly the same weight as comments provided orally or in written format to MDA during a public hearing. This PEIS is being prepared to address the potential environmental impacts of alternatives for implementing the proposed BMDS. The PEIS is a resource to help

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			MDA decision makers determine the environmental impacts of implementing the BMDS as an integrated system. The MDA has fulfilled the requirements of NEPA and has encouraged public participation throughout this process.
NEPA Process	PHO0051-5	The second thing that I would like to talk bout is five minutes. How long did it take you to put this study together? You all only give us five minutes to comment. I don't understand that.	In addition to the public hearings, the MDA developed a publicly accessible web site to provide information on the BMDS PEIS and request comments on the Draft PEIS. The MDA also established toll-free phone and fax lines, an e-mail address, and a U.S. postal service mailbox for submittal of comments and questions. Both the NOA of the Draft PEIS published in the FR and the BMDS PEIS web site provided instructions on submitting comments on the Draft PEIS. Comments received via any of the methods identified carry exactly the same weight as comments provided orally or in written format to MDA during a public hearing. As explained during the public hearing the five minute time limit was provided to ensure that all participants had the opportunity to provide their comments. After all participants had an opportunity to speak for up to five minutes, any commenter who wished to provide additional oral comment was invited to do so.
NEPA Process	PHW0001-1	Here, MDA has ignored the highly controversial nature of the missile defense program; has, over the years, issued a series of separate environmental analyses on smaller parts of the entire system, so as to avoid the cumulative impact test, and the nature of the proposed layered integrated BMDS program described in this PEIS is so substantially different from earlier iterations that any reliance on many	This PEIS is being prepared to address the potential impacts of implementation alternatives for the proposed BMDS. As described in Section 2.1.3 of the PEIS, the system acquisition process historically has focused on the development of independent stand-alone defensive elements. Consistent with this approach, the MDA developed NEPA analysis that appropriately considered

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		of those earlier environmental analyses is misplaced. They simply will not pass muster. And, as the Ninth Circuit instructed another agency in a case involving a controversial proposal, "... the term 'controversial' refers to cases where a substantial dispute exists as to (the) size, nature, or effect of the major federal action rather than to the existence of opposition to a use. Foundation for North American Wild Sheep v. United States Department of Agriculture, 681 F 2d 1172(9th Cir.1982).	the impacts of these stand-alone systems. The MDA is now working to incrementally develop and field a BMDS that layers and integrates defenses to intercept ballistic missiles in all ranges of flight. Therefore, it is now appropriate for the MDA to prepare a PEIS which discusses the environmental impacts of such a proposed system. Future site-specific analyses necessary to support proposes tests or new developments of the BMDS will tier from this PEIS. Both this PEIS and future analyses consider cumulative impacts, as appropriate.
NEPA Process	PHW0002-7	Another issue that is raised and not explored fully is the testing and deployment of missile defense systems abroad, or OCONUS as it is referred to here. The document asserts, "MDA may also develop test beds in other areas such as the Atlantic Ocean, Gulf of Mexico, or outside the continental U.S. to support testing of BMDS components in those areas." (p. 2-28) But it does not say how this would occur, only that "Because NEPA and other environmental laws generally do not apply to OCONUS activities, various EOs and other DoD directives and instructions have been implemented." (p. 4-111) However, nothing specific has been given on how these laws were implemented; rather, the draft PEIS directs the reader to Appendix G, which is a long listing of international treaties and does not explicitly state how the missile defense systems fit into these commitments. Given how unpopular missile defense is amongst the Canadian, British, and Greenlandic publics - the three countries that are the nearest to being incorporated into the BMDS - this should be explained further.	The PEIS considers the potential impacts of BMDS activities on multiple biomes where the BMDS could be implemented. The PEIS is not site-specific and therefore does not consider specific treaties or agreements that would apply at particular sites where the BMDS could be implemented. If specific activities are proposed in locations outside the continental U.S. (OCONUS) including Canada, United Kingdom, and Greenland, the MDA would work with the appropriate authorities to ensure that all applicable requirements are met.

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NEPA Process	PHW0009-1	1) The PEIS appears to be biased towards minimizing the environmental impact of the BMDS. There is an inherent conflict of interest win this report being written by the MDA, which has a stake in the BMDS project proceeding. An independent environmental impact report should be commissions by a nonpartisan panel of scientists with expertise in the field.	Instruction 4715.9, Environmental Planning and Analysis, Presidential EO 12114, Environmental Effects Abroad of Major Federal Actions, and applicable DoD military service environmental regulations that implement these laws and regulations. Section 1506.5(c) of the CEQ NEPA Regulations outlines the lead agency's responsibility with respect to preparing an EIS. This Section states that "…any environmental impact requirements of NEPA shall be prepared directly by or by a contractor selected by the lead agency…" Therefore, the PEIS was prepared appropriately as directed by the CEQ guidelines.
No Action Alternative	E0158-1	I can't support anything but a True "NO ACTION".	As noted in CEQ's "Forty Most Asked Questions", there are two interpretations of the No Action Alternative depending on the nature of the proposal being evaluated. In situations where "no action" is illustrated in instances involving Federal decisions on proposals for project "no action" would mean the proposed activity would not take place. In situations that involve an action such as updating a land management plan where ongoing programs initiated under existing legislation and regulations will continue, even as new plans are developed, "no action" may be thought of in terms of continuing with the present course of action until that action is changed. It is further noted that to construct an alternative based on no management at all would be a useless academic exercise. For this PEIS, because the proposed action involves the integration of existing discrete missile defense systems, the no action alternative would be to continue with existing stand-alone systems; not to scrap all existing systems like the

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			PATRIOT missile already in use in theater defense by U.S. forces.
No Action Alternative	E0162-2	Another major general deficiency is that the No Action alternative is not considered seriously. It is asserted on page 2-67 that it "would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress." Footnote.19 on page 1-6 quotes the part of the 1999 Missile Defense Act which declares a policy to "deploy as soon as is technologically possible an effective NMD system." It is noted on page 1-6 that Pres. Clinton decided in Sept. 2000 not to authorize deployment of an NMD system for reasons including technical uncertainties and unsuccessful flight tests. Two GAO reports in 2003 and a Union of Concerned Scientists report Technical Realities in May 2004 raise serious questions about the readiness for deployment of current NMD components. Therefore, it seems that the No Action alternative (which was essentially U.S. policy until 2002) is preferable until one can demonstrate that an "effective" NMD is "technologically possible." The most recent NMD intercept attempt failed on 11 Dec. 2002, six days before Pres. Bush announced that the U.S. would deploy an initial NMD system. The test results so far and independent analyses suggest that it is at least questionable whether an effective NMD system is possible.	See previous response.
No Action Alternative	E0179-1	I believe that halting the project is the best option.	See previous response.

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No Action Alternative	E0186-1	To continue on with this project as would be the case even under the "no action alternative" is unconscionable. We believe that even if you were to re-do the PEIS, there would be no reasonable alternative other than shutting down the project and calling it the loss it already is.	See previous response.
No Action Alternative	E0204-1	It is my understanding that Alternative 3 means "no change" so that all programs continue as planned. This is not acceptable. The statement must be rewritten to allow for a true "no action" choice....meaning NO R&D or Production of the missile defense program, no weapons in space!	See previous response.
No Action Alternative	E0211-1	The PEIS must be rewritten, because the "No action" alternative is insufficient. The most appropriate choice is to stop all funding of Star Wars Missile defense.	See previous response.
No Action Alternative	E0211-2	I want no more of my tax dollars to support this foolish program. Please rewrite the PEIS to allow the sanest alternative- scrapping this program entirely- to be a choice. The best choice.	See previous response.
No Action Alternative	E0216-1	For all these reasons I believe the "No Action Alternative" is insufficient and the entire PEIS should be rewritten.	See previous response.
No Action Alternative	E0231-1	The definition of no action to me is to STOP WHAT IS NOW BEING DONE!!!	See previous response.
No Action Alternative	E0233-1	None of the three options for PEIS is acceptable! The third is the most dangerous because it is so deceptive, meaning "business as usual." Let's scrap this entire frivilous program and get on with the vital business of remediation of the mistakes of the past four years and prevention of more of the same during the second Bush administration.	See previous response.
No Action Alternative	E0262-1	I am writing in opposition to the three options of the MDA BMDS PEIS, including the No Action option, since it is in	See previous response.

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		reality not a true No Action as it includes continued development of interceptors. I urge you to revise these options with more concern for the environmental damages that will result from these actions.	
No Action Alternative	E0270-1	The"No Action Alternative" is insufficient and the entire PEIS should be rewritten. No nukes in space!!!!!!	See previous response.
No Action Alternative	E0319-27	Regarding the BMDS Draft PEIS and No Action Alternative, the MDA comments: "This alternative would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress to defend the U.S. against ballistic missile attack". Perhaps the PEIS could explain exactly what the President and Congress have proposed for the BMDS, because the MDA evidently does not know 'the specifics of the final architecture or operational requirements' otherwise, the information would have been included in the Draft PEIS, so the public would have an Alternative 3 option to comment on that did not include 'exploding' missiles in space or firing space-based lasers at ground targets, which eventually will lead to the U.S. Department of Defense's control of space by the year 2020 (U.S. Air Force, Vision 2020).	See previous response.
No Action Alternative	E0332-1	1. The three alternatives being considered are insufficient and deceptive. "No Action" is an endorsement of the current ABM program which is badly flawed and which should be terminated. The PEIS as it is being conducted does not meet congressional requirements and must be started over with real alternatives.	See previous response.

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No Action Alternative	E0343-1	I am writing to support a real "No Action" alternative to the deployment of a missile defense system. This means no further testing, development, or deployment.	See previous response.
No Action Alternative	E0355-1	Alternative 3, "No Action," which might seem like a logical out for those wanting to suppress this race to destruction, seems to leave things as they are - i.e. would allow continuation of the present programs which we are against! So the PEIS should be rewritten to allow another alternative: Discontinue all work on such systems, and work on getting cooperation throughout the world on disarmament.	See previous response.
No Action Alternative	E0366-1	(5) For all of the above, and many more, we believe that the only acceptable alternative is for NO BALLISTIC MISSILE SYSTEM AS OUTLINED IN THIS PEIS. Note that does not mean the vno action alternative' IT MEANS NO PROGRAM.	See previous response.
No Action Alternative	E0373-1	Since it appears that "no action" in this context means "carry on with the plan", the three alternatives being considered by PEIS are all unacceptable.	See previous response.
No Action Alternative	E0387-6	Yorkshire CND asks that our concerns be taken seriously and considered properly. The PEIS has offered itself three options, none of which is sufficient. As we understand it, the "no action" option simply allows for no change in current developments and the continuation of the project. If this is to be the ultimate step that the MDA is prepared to take then it implies a bias towards the outcome of this PEIS study by not allowing for the possibility that the Missile Defence system is too environmentally destructive to continue with.	See previous response.
No Action Alternative	E0395-4	What is called the "No Action Alternative" is not adequate under NEPA and does not describe a scenario where no	See previous response.

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		action is taken. Rather it describes a situation where the Missile Defense Agency would continue existing development and deployment of missile defense systems unabated. Under the "No Action Alternative" individual systems would continue to be tested and deployed except for integrated system-wide tests. This is hardly no action and would permit an indeterminate missile defense program, especially since, as explained in the draft, "There are currently no final or fixed architectures and set of requirements for the proposed BMDS." Even if MDA agreed to the "No Action Alternative," it would not find its actions constrained for the foreseeable future. The MDA needs to develop new alternatives which meet the intent of NEPA.	
No Action Alternative	E0395-5	Most crucially, the "No Action Alternative" strangely links world events, policy objectives with environmental considerations; unprecedented in an environmental document which is supposed to be grounded in the science of risk assessment. The PEIS reads: "The decision not to deploy a fully integrated BMDS could result in the inability to respond to a ballistic missile attack on the U.S. or its deployed forces, allies, or friends in a timely and successful manner. Further, this alternative would not meet the purpose of or need for the proposed action or the specific direction of the President and the U.S. Congress." Through the MDA's own volition, the document goes beyond environmental considerations and opens a Pandora's Box of analyzing the state of American security,	See previous response.

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		the potential for missile attack, and the appropriate policy responses. Therefore, it is now MDA's responsibility to respond to all public comment on threat and policy, even those challenging the rationale for missile defenses. Now that the Pandora's Box is open on policy, the Missile Defense Agency should, for example, make the case that nuclear deterrents no longer suffice, and MDA should substantiate why BMDS is the preferable security strategy over other Alternatives by which America might be kept safe, such as through United Nations IAEA inspections, international controls on missile sales and missile technology, or diplomacy.	
No Action Alternative	E0395-6	If the agency choices to maintain the current "No Action Alterative" - which we do not support - the final PEIS would need to offer a realistic analysis (and timeline) of missile threats against the American homeland, nor fudge the distinction between theater and strategic threats. Further, the "No Action Alternative" would eliminate systems integration testing, the very testing that would be needed to demonstrate that a layered missile defense system, as ordered by the President, can work. Elsewhere in this PEIS the President's direction is cited as a reason why no further change in the plan is being considered, but in the "No Action Alternative," the President's direction is clearly negotiable.	See previous response.
No Action Alternative	E0402-1	I think the most important issue is that the BMDS PEIS does not contain a real No Action Alternative. Your No Action alternative which many people think is a good option really only states that the entire plan be	See previous response.

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		implemented as already underway with only the exclusion of the new layered additions. A real No Action alternative, stops the implementation of the nuclear missile defense system.	
No Action Alternative	E0402-3	Therefore, given the potential severe environmental damage from both testing and deployment of this program, a true no action policy is preferable.	See previous response.
No Action Alternative	E0423-1	Now for the larger picture. The BMDS PEIS does not include a real "No Action Alternative" of not developing ballistic missile defenses, Like a number of medical treatments, from bleeding people hundreds of years ago to Viox a month ago, the remedy is worse than doing nothing.	See previous response.
No Action Alternative	E0424-3	4) The BMDS PEIS does not include a real "No Action Alternative". Such an alternative that does not include further development testing or deployment of BMDS weapon systems needs to be considered and included in the PEIS. Such a "No Action Alternative" would include strong support for efforts by the UN and nations around the world to enhance security through strengthening inspection and verification protocols of existing treaties, and by re-commitment to arms control and disarmament approaches that to date have served to limit global Weapons of Mass Destruction (WMD) proliferation. As such, the PEIS needs to consider explicitly whether the BMDS would itself encourage the proliferation of WMD, as well as an arms race in space, with examination of the likely response of other nations to the BMDS. As the BMDS is coupled to continued U.S. nuclear weapons	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
		programs, will this lead other nations horizontally proliferate for "deterrence" capabilities?	
No Action Alternative	E0427-1	3) The BMDS PEIS does not include a real "No Action Alternative". Such an alternative that does not include further development testing or deployment of these weapon systems needs to be considered and included in the PEIS. The BMDS PEIS has not considered the "No action Alternative" of re-joining the UN and many nations of the world in working to enhance security through treaties and arms control and disarmament approaches, e.g. the approach that has provided us with long-term security to date.	See previous response.
No Action Alternative	E0429-1	Furthermore, the PEIS lacks a genuine "No Action Alternative," even though NEPA requires that such an alternative serve a baseline against which to compare the environmental impacts of the other alternatives. In particular, a No Action Alternative that posits little or no use of rocket propellant is essential if the program's proponents are to minimize releases of pollutants - particularly solid rocket propellant and its byproducts into our nation's water supplies, air, or the upper atmosphere, either by selecting a program alternative or agreeing to binding mitigation measures.	See previous response.
No Action Alternative	E0429-8	The PEIS lacks a genuine, "No Action Alternative," as required under NEPA. It rejects evaluation of the alternative, "Cancel Development of Ballistic Missile Defense Capabilities," because it "does not meet the purpose of or need for the proposed action ..." (page 2-68). This approach misunderstands how NEPA works. It is acceptable to evaluate and reject a No Action Alternative because it doesn't meet the purpose of a program, but the	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
		environmental impacts of that alternative must be considered as a baseline against which to compare the environmental impacts of the other alternatives. In particular, a No Action Alternative that posits little or no use of rocket propellant is essential if the program's proponents are to minimize releases of pollutants into our nation's water supplies, air, or the upper atmosphere, either by selecting a program alternative or agreeing to binding mitigation measures.	
No Action Alternative	E0439-1	3) The BMDS PEIS does not include a real "No Action Alternative". Such an alternative that does not include further development testing or deployment of these weapon systems needs to be considered and included in the PEIS. The BMDS PEIS has not considered the "No action Alternative" of re-joining the UN and many nations of the world in working to enhance security through treaties and arms control and disarmament approaches, e.g. the approach that has provided us with long-term security to date.	See previous response.
No Action Alternative	F0005-3	Another major deficiency of the draft PEIS is that it lacks a genuine "No Action Alternative", even though NEPA explicitly requires that such an alternative serve as a baseline against which to compare the environmental impacts of the other alternatives. LAWS is compelled to conclude that the MDA simply did not consider a "No Action Alternative" seriously. For example, the MDA asserts on page 2-67 that "it would not meet the purpose of or need for the proposed action or the specific direction of the President and the U. S. Congress." Further, footnote 19 on page 1-6 quotes the part of the 1999 Missile Defense	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
		Act which declares the policy "to deploy as soon as is technologically possible an effective NMD system." The PEIS also notes on page 1-6 that President Clinton decided in September 2000 not to authorize deployment of an NMD system for reasons including technical uncertainties and unsuccessful flight tests. The PEIS does not concede that even if the technology worked perfectly, the systems being deployed are vulnerable to counter-measures that are easier to build than the long-range missile on which they would be placed, another concern that contributed to President Clinton's decision not to deploy the system the Bush Administration is now rushing to deploy.	
No Action Alternative	F0005-4	In addition, two GAO reports in 2003 and a Union of Concerned Scientists report titled 'Technical Realities" released in May, 2004 raise further serious questions about the readiness for deployment of the current NMD components. It seems clear to LAWS that a properly-articulated "No Action Alternative"-which was essentially U.S. policy until 2002 - is vastly preferable until the MDA can persuasively demonstrate that an "effective" NMD is "technologically possible." Recent test results underscore this reality. The most recent NMD intercept attempt failed on December 11, 2002, six days before President Bush announced that the U. S. would deploy an initial NMD system. This rush to deploy an untested system flies in the face of the test results so far, and suggests that the independent analyses that state that it is at least questionable whether an effective NMD system is possible, have been ignored. The policy stakes are far too	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
		high, and the $10 billion annual expenditures far too great, to proceed with this global gamble.	
No Action Alternative	F0005-5	The width of the range of alternatives that an agency must identify and analyze in an EIS is based on the purpose of, and need for, the agency action. (See 40 C.FR: Sec. 1502.13,1502.14.) Therefore, a narrow project purpose and need requires a fewer number of reasonable alternatives than a broad project purpose and need, which may have an infinite number of alternatives. (See NRDC v. Morton, 458 F.2d 827, 835; D.C. Cir. 1972)	See previous response.
No Action Alternative	F0005-10	As pointed out above, instead of crafting the PEIS to justify decisions that have already been made, the MDA should have included a genuine "No Action Alternative", as required under NEPA. Such an alternative could have been "Cancel Development of Ballistic Missile Defense Capabilities" because it does not meet the purpose of or need for the proposed action. It is acceptable under NEPA to evaluate and reject a No Action Alternative because it doesn't meet the purpose of a program, but the environmental impacts of that alternative must be considered as a baseline against which to compare the environmental impacts of title other alternatives.	See previous response.
No Action Alternative	M0234-1	The NO ACTION alternative is the only acceptable option, but one in which there would be NO FURTHER RESEARCH OR DEVELOPMENT of "Missile Defense" systems or "Space Based Weapons."	See previous response.
No Action Alternative	M0234-2	So our basic conclusion would be that a NO ACTION alternative, that truly means NO ACTION, cutting off all funding for any further development of BMDS or sub-systems of it.	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
No Action Alternative	M0262-1	For all these reasons, I support ending all work on the Missile Defense system. None of the alternatives presented in your Draft Programmatic Environmental Impact Statement includes ending the program. Therefore, I call on you to rewrite and resubmit the PEIS for public comment, including another alternative: ending the Missile Defense System.	See previous response.
No Action Alternative	M0266-1	The existing text for Alternative 3 is not a NO ACTION alternative. The MDA itself rejects it as an inadequate version of the first two alternatives presented.	See previous response.
No Action Alternative	M0266-2	1). Beginning in January 2005 the current Ballistic Missile Defense Program (BMD) would be suspended immediately and in entirety, or a moratorium on deployment, research and development would be declared while a thorough investigation of the program occurs. Congress, the Administration, auditors, scientists, aerospace engineers and the general public would participate in a thorough reconsideration of the costs, workability and desirability of this program in all its aspects.	See previous response.
No Action Alternative	M0274-1	I believe the "no action" alternative is an insufficient brake to further Star Wars developments. I strongly urge a intensive rewriting of PEIS.	See previous response.
No Action Alternative	PHO0007-1	This proposal that we're asked to address tonight does not contain a real No Option Alternative not to build the system, to abandon it. That is what I think most of the people in the United States and the world would affirm.	See previous response.
No Action Alternative	PHO0009-2	The second thing is the PEIS does not evaluate the environmental impact of No Action Alternative; thus, does not comply to the National Environmental Policy Act.	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
No Action Alternative	PHO0009-3	The report -- since No Action Alternative was not considered seriously in the impact report, I say it is not an impact report at all. Therefore, it has not complied with the legal requirements; therefore, it should be stopped. Thank you.	See previous response.
No Action Alternative	PHO0011-6	The BMDS does not include a real No Action Alternative. Such an alternative does not include further development and testing and deployment of these weapon systems needs to be considered and included in the PEIS. The PEIS does not consider a No Action Alternative at all. In other words, something that would involve rejoining the UN and -- and many other nations of the world in order to enhance security through treaties and arms control, sovereign approaches; i.e., approaches that provided us with long-term security to date.	See previous response.
No Action Alternative	PHO0013-1	And I suggest an Alternative Number 4, which means scrap the entire PEIS and the whole program that they are presenting here.	See previous response.
No Action Alternative	PHO0018-1	First, I call for a true No Action Alternative, as have others. For example, or specifically, an alternative that goes beyond the failure to integrate anti-ballistic missile system to an alternative that rejects the individual missile defense elements of a BMD System.	See previous response.
No Action Alternative	PHO0018-2	Because of the devastating impacts -- political, environmental, ecological and psychological, as well as merely environmental -- the impacts of a Ballistic Missile Defense Program of any kind, this PEIS must address a true No Action Alternative. The failure of this PEIS to include such a true No Action Alternative violates the requirements of the NEPA process. The absence of a true No Action Alternative allows the PEIS to construct a false	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
		comparison with the other alternatives underplaying the different degrees of environmental damage.	
No Action Alternative	PHO0019-1	You have no true No Action Alternative; only build it together or build it a little bit at a time and don't test it together.	See previous response.
No Action Alternative	PHO0019-2	What you should do in your own terms is to consider a true No Action Alternative, which is an analysis of the relative emissions of greenhouse gasses and space debris and toxic chemicals and radiation caused by either (A), blowing things up or (B), pursuing broader implementations of existing treaties, such as the Nuclear Non-proliferation Treaty and the Anti-Ballistic Missile Treaty, which would not produce any greenhouse gasses, any space debris and would not blind any animal or destroy any life on Earth. Thank you.	See previous response.
No Action Alternative	PHO0024-1	This is reason enough for the No Project Alternative CEQ style.	See previous response.
No Action Alternative	PHO0026-2	With respect to the No Action Alternative already mentioned by others, it does not describe a scenario where no action is taken. Rather, it describes a system where the Missile Defense Agency would continue existing development and deployment unabated under the No Action Alternative. And I quote the PEIS here, Individual systems would continue to be tested but would not be subjected to system integration tests, closed quotes. This is hardly no action and allows for indeterminate missile defense program since -- to go back to quoting the PEIS, There are currently no final fixed architectures and no set operational requirements for the proposed BMDS, closed quotes.	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
No Action Alternative	PHO0032-2	We would support the No Action Alternative if there had been a legitimate attempt at researching and weighing a true alternative of no action. Such a proposal should have encompassed a suspension of research and development, no testing and no initial deployment. It should have evaluated the cost effectiveness of vigorous pursuit of international cooperation on nuclear disarmament. As it stands, the No Action Alternative does not meet the requirements of the National Environmental Policy Act. For this reason, we consider the Draft PEIS inadequate and insufficient for proceeding with the BMDS.	See previous response.
No Action Alternative	PHO0037-6	And, last, the BMDS PEIS does not really include a No Action Alternative. Your No Action Alternative does not include the option of not deploying any of these, there's just dropping the program right now. And I think that we need to have a true No Action Alternative considered as part of this.	See previous response.
No Action Alternative	PHO0038-1	I, like Jean, am in favor of the No Action Alternative, but would also like a real No Action Alternative, which would save us tens to hundreds of billions of dollars if we didn't deploy the system.	See previous response.
No Action Alternative	PHO0039-1	I'd like to see something quite a bit less than the No Action Alternative, I'd really like to see something rolled back in a way and dismantling and using these resources, the financial resources that were wasted on this on much more pressing needs in this country.	See previous response.
No Action Alternative	PHO0044-6	The No Action Alternative is not seriously considered. It is claimed not to be at the direction of Congress, presumably the 1999 Missile Defense Act. This Act states	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
		U.S. policy is to deploy as soon as is technologically possible an effective NMD system, but the EIS has no discussion about NMD effectiveness and whether that criteria is satisfied.	
No Action Alternative	PHO0045-1	We support a real No Action Alternative to the deployment of a missiles defense system. This means no further testing, development or deployment.	See previous response.
No Action Alternative	PHO0046-1	I think that you have inadequate alternatives. You only have three alternatives and there ought to be a fourth one which includes not deploying, developing the Ballistic Missile Defense System, and actually reducing the scope of existing programs.	See previous response.
No Action Alternative	PHO0048-3	NEPA requires the alternatives to be considered, including the No Action Alternative, as has already been stated.	See previous response.
No Action Alternative	PHO0048-5	And the reason for this, the reason why this is justified is because they're getting off on a technicality, because they stated that the purpose of this program or this project is to implement a Ballistic Missile Defense System. It's misleading, because really what this project is supposed to do, like the overriding principle, is to provide for the defense of the United States.	See previous response.
No Action Alternative	PHO0049-2	Then, finally, I wanted to say that in your EIS I think you're misleading all of us by putting No Action as a third alternative. I think you need to be more honest and state specifically that No Action means to keep on testing as is without the integration.	See previous response.
No Action Alternative	PHO0049-3	I think that some of the people here felt like No Action meant that you were going to start dismantling the missile defense system, which, of course, should have been stated as another alternative, which you didn't even give us a chance to put down.	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
No Action Alternative	PHO0049-4	And please give us another alternative which says stop Star Wars, dismantle the missile defense system, start helping the people who really need the help, and let's bring peace instead of more destruction.	See previous response.
No Action Alternative	PHW0001-5	The PEIS is defective to the extent that it fails to meet the CEQ guidance on the range of alternatives agencies must consider. Here, the MDA has failed to propose a real no action alternative, and the so-called no action alternative set out at PEIS 2-67 is not a true no action alternative because under it all the individual components of the system would continue to be tested to determine the adequacy of their stand-alone capabilities. Such an alternative could easily have been Alternative 3, but the MDA should also have clearly set out a real no action alternative so that the public could comment on it, instead of being caught in the Catch-22 this PEIS poses. It is difficult not to conclude that the agency's choice of alternatives was dictated by the end result it desired. While there may be portions of the CEQ guidance where reasonable people may differ, surely this is not one of them. And LAWS submits that a reviewing court would find the range of alternatives set out in the PEIS inadequate, in view of all the circumstances.	See previous response.
No Action Alternative	PHW0002-1	To begin with, the so-called "No-action alternative" examined in this document is misleadingly named. It does not detail a scenario where no action is taken. Rather, it describes a system where "the MDA [Missile Defense Agency] would continue existing development and testing of discrete systems as stand-alone missile defense capabilities. Individual systems would continue to be tested but would not be subjected to system integration	See previous response.

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		tests." (p. ES-8) This is hardly no action and allows for an indeterminate amount of missile defense development, since "There are currently no final or fixed architectures and no set operational requirements for the proposed BMDS." (p. 1-9) The way this draft PEIS is structured, even if MDA was limited to the No-action alternative, it would not find its actions very much constrained.	
No Action Alternative	PHW0004-1	Furthermore, the PEIS lacks a genuine "No Action Alternative," even though NEPA requires that such an alternative serve a baseline against which to compare the environmental im¬pacts of the other alternatives. In particular, a No Action Alternative that posits little or no use of rocket propellant is essential if the program's proponents are to minimize releases of pollutants-particularly solid rocket propellant and its byproducts-into our nation's water supplies, air, or the upper atmosphere, either by selecting a program alternative or agreeing to binding mitigation measures.	See previous response.
No Action Alternative	PHW0004-8	The PEIS lacks a genuine, "No Action Alternative," as required under NEPA. It rejects evaluation of the alternative, "Cancel Development of Ballistic Missile Defense Capabilities," because it "does not meet the purpose of or need for the proposed action ..." (page 2-68). This approach misunderstands how NEPA works. It is acceptable to evaluate and reject a No Action Alternative because it doesn't meet the purpose of a program, but the environmental impacts of that alternative must be considered as a baseline against which to compare the environmental impacts of the other alternatives.	See previous response.

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		In particular, a No Action Alternative that posits little or no use of rocket propellant is essential if the program's proponents are to minimize releases of pollutants into our nation's water supplies, air, or the upper atmosphere, either by selecting a program alternative or agreeing to binding mitigation measures.	
No Action Alternative	PHW0005-2	We would support the "No Action Alternative," if there had been a legitimate attempt at researching and weighing a true alternative of "no action/' Such a proposal should have encompassed a suspension of research and development, no testing, and no initial deployment. It should have evaluated the cost-effectiveness of vigorous pursuit of international cooperation on nuclear disarmament. As it stands, the "No Action Alternative" does not meet the requirements of the National Environmental Policy Act. For this reason, we consider this draft PEIS inadequate and insufficient for proceeding with the BMDS.	See previous response.
No Action Alternative	PHW0006-2	2. The PEIS does not evaluate the environmental impact of the no action alternative, and thus does not comply with the intent of the National Environmental Policy Act. Without this evaluation there is no way to compare the environmental impact of the program to the impact of the no action alternative, and thus violates both the letter and the spirit of NEPA.	See previous response.
No Action Alternative	PHW0009-2	4) The "No Action Alternative" is not fairly presented or considered. The alternative of the worldwide elimination of ICBM's through diplomatic means and international cooperation, including worldwide imposition of UN arms inspections.	See previous response.

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Issue Topic	Comment Number	Excerpt Text	Response
Procedural	E0319-28	Most likely, Volume 1 of the BMDS PEIS has already been printed and the MDA is waiting to receive and include public comments before releasing it and publicly announcing to the news media that the BMDS is 'deployed'.	MDA considered all comments received during the public comment period and made changes to the document as appropriate. Any modifications based on comments are outlined in this appendix.
Procedural	E0395-3	The timeline to release the Final PEIS - cited on the MDA web-site and announced at the October 19, 2004 public meeting - a mere two to six weeks after the comment period deadline portends that MDA will not fully consider and respond to public testimony. PSR-LA emphatically suggests that MDA take the time to consider and respond in full to all comments and critiques.	Based on the number of comments received, MDA extended the original release date of the Final PEIS in order to adequately consider public comments.
Procedural	PHO0023-1	Most notably, I would like to point out that the timeline of potentially releasing the final document but two weeks after the oral testimony, as well as what anyone else could offer in writing and -- or even six weeks later into -- in the end of January of '05 strikes me that you very well may not take too seriously what we have to say. I would strongly suggest that you factor a time when you can actually take into account the things that the public are suggesting.	See previous response.
Procedural	PHW0001-7	As LAWS and PSR pointed out in their Vandenberg EA comments, "The issues are too important, and the priority accorded this program would suggest to a reviewing court that rather than risk extended delays inherent in legal challenges to the sufficiency of this (PEIS), the MDA would be well advised to take the time and make the effort to prepare a comprehensive (PEIS) that fully meets all the legal requirements of NEPA." That is still good advice. While the PEIS is an improvement in some respects, it remains fatally flawed. LAWS and PSR and others will	See previous response.

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		spell out these fatal flaws in the written comments that are due November 17, 2004.	
Procedural	PHO0037-1	Three, NEPA does not seem, to me, to be a big enough vehicle to evaluate the program. It should include international input because the implications of this project are global. And I noticed on your map out there Antarctica is not included on the map. I'm sure you looked at it but.....	The PEIS addressed the international scope of the BMDS program by describing world environments in terms of global biomes. Appendix G also discusses compliance with applicable international environmental and safety regulations. Antarctica was not included on the map or in the analysis because there are no reasonably foreseeable BMDS actions proposed to take place in Antarctica. If there were future BMDS activities proposed in this area, they would be addressed in site-specific environmental documentation.
Procedural	PHO0051-6	The other thing is, and people have already commented that you don't have any person here that can translate our language.	Attendees at the public hearing were given the opportunity to provide testimony in both Hawaiian and Marshallese languages. A court reporter recorded the proceedings and the audiotapes were later translated by certified translators. Transcripts from the hearings, including the translated Marshallese and Hawaiian oral testimony, can be found in Appendix B of this PEIS.
Procedural	PHO0055-1	KELI'I COLLIER: Okay. Not much. So when you say that you weigh the written testimony as heavy as the oral testimony, that premise alone is a fault of yours, it's a fault of your thinking, it's a fault of your understanding of where you are, this context of Hawaii. These people can barely feed themselves half the time. They can barely send their kids to school with slippers. So that's something you got to wake up to fast.	Approximately 8,500 comment documents were received on the Draft BMDS PEIS. Comments received via any of the methods identified carry exactly the same weight as comments provided to MDA orally during a public hearing.
Proposed Action	E0347-3	The long-established US satellite-surveillance downlink and relay Bases, such as Menwith Hill and Pine Gap,	The proposed action analyzed in this PEIS includes analysis of various components that could be integrated

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		positioned around the world for the purpose of intelligence gathering, are necessary components of the US Missile Defense System, as they would be used to monitor in advance, the preparations for the launch of a rocket. These facilities comprise part of the US Missile Defence system package and exclusion from the US Missile Defence Agency's Programmatic Environmental Impact Statement deliberations cannot be justified.	into the BMDS. The PEIS analyzes components rather than elements because the MDA acquisition strategy has changed significantly as described in Section 3.1.2 of the PEIS. The components of the various elements deployed at locations around the world are analyzed as part of this PEIS.
Proposed Action	PHO0046-6	So I say that that needs to be considered. The opportunity costs of ballistic missile defense is one of the impacts that we have to deal with and our children have to deal with, and it needs to be considered in your Environmental Impact Statement, and I didn't see it listed there.	This PEIS is being prepared to consider and analyze the potential environmental impacts of alternatives for implementing the proposed BMDS. The PEIS is a resource to help MDA decision makers determine the environmental impacts of implementing the BMDS as an integrated system. Cost associated with system development and testing is addressed by the Congress during the budgeting process and is not relevant to this environmental analysis.
Public Involvement	E0319-1	The MDA did a very poor public relations job in regard to getting the word out on the availability of the Draft PEIS and on the October 2004 public hearings in what will be the affected BMDS test communities. The public cannot make comments on something they do not know exists if it is not well advertised in advance (e.g. notices in newspapers). Holding public hearings in Anchorage, Alaska when the BMDS test site is located on Kodiak Island, Alaska, and in Sacramento, California when the test site is at Vandenberg AFB near Los Angeles, showed the MDA's intent was to make it as difficult as possible for members of the public to travel to the meeting places to testify and give their comments on the Draft PEIS. The MDA put a public notice in the Kodiak Daily Mirror and	The PEIS is a programmatic level NEPA analysis that considers implementation alternatives for an integrated BMDS and as such does not address specific sites or specific activities at those sites, but rather considers the program as a whole to allow tiering of subsequent site-specific analyses from the PEIS. MDA planned to hold its public hearings on the Draft PEIS in the same locations at which scoping meetings were held. Notification of the BMDS PEIS scoping meetings was published in the Kodiak Daily Mirror on April 30, 2003 and May 2, 2003 and notification of the BMDS PEIS public hearings was published in the Kodiak Daily Mirror on October 13, 2004 and October 15, 2004. A

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		sent a copy of the Draft PEIS to the Kodiak Island Borough's office only after being urged by local residents. Otherwise, local officials and community members would not have known of its existence. This repetitive MDA behavior is unacceptable.	scoping notification letter was sent to Mayor Carolyn Floyd in April 2003 and a copy of the Draft PEIS was provided to Mayor Floyd in September 2004.
Public Involvement	E0395-2	Communities most impacted by BMDS have been largely excluded from the environmental review process. For example, communities near Vandenberg AFB will disproportionately bear the burden of the proposed 515 launches over the next ten years. And, the PEIS has not sufficiently dealt with the effect of cumulative effects in Southern California, as many of the region's contractors are working on the weapon system. Simply, there needs to be additional hearings in potentially impacted areas of the nation.	It is not possible to hold public hearings at all locations where activities associated with implementing the BMDS may occur. MDA planned to hold its public hearings on the Draft PEIS in the same locations at which scoping meetings were held. The PEIS is a programmatic level analysis that considers implementation alternatives for an integrated BMDS and as such does not address specific sites or activities at these sites, but rather considers the program as a whole to allow tiering of subsequent site-specific analyses from the PEIS. In addition to the public hearings, the MDA developed a publicly accessible web site to provide information on the BMDS PEIS and request comments on the Draft PEIS. The MDA also established toll-free phone and fax lines, an e-mail address, and a U.S. postal service mailbox for submittal of comments and questions. Both the NOA of the Draft PEIS published in the FR and the BMDS PEIS web site provided instructions on submitting comments on the Draft PEIS. Comments received via any of the methods identified carry exactly the same weight as comments provided orally or in written format to MDA during a public hearing.
Public Involvement	PHO0025-4	Southern California is bearing a disproportionate impact of missile defense development and its effects on the environment. The midcourse interceptor is being tested	See previous response.

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		and deployed at Vandenberg Air Force Base in Santa Barbara County. The Airborne Laser is being tested at Edwards Air Force Base in Los Angeles County. The space-based and Airborne Lasers are being developed by Northrop Grumman in the South Bay and San Juan Capistrano. Lockheed Martin, Boeing and Raytheon are deeply involved in developing the midcourse interceptors and other systems. At a minimum, there should be additional hearings near the areas most effected by missile defense developing.	
Public Involvement	PHO0029-1	But now I don't think so anymore because I'm noticing that there were only four locations at all where public testimony has been invited: Virginia, Sacramento, California, Hawaii and Alaska. That seems to me to be not nearly enough public input. That point has already been made. I would like to talk about Exhibit ES-3, which is part of the Executive Summary. If you want to go along with me, that exhibit shows the effected environment. This is about environment that we're talking about here today. I looked at that to see what the affected environment was. All of the environment that can be affected is divided into nine biomes, as well a broad ocean area and the atmosphere. I went through that and I saw the following. I saw that we're talking about the Arctic regions, North Atlantic Ocean, Pacific Ocean, Alaska, Canada and Greenland. Then some more Arctic regions and also Alaska, deciduous forest and Eastern and North Western U.S. and	See previous response.

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		Europe, Chaparral. That is California Coast, Mediterranean from the Alps to the Sahara Desert, from the Atlantic Ocean to the Caspian Sea. This is a lot of area here. And these are areas that are labeled as "affected areas." Oh, the Grasslands. That is the whole prairie of the Midwest. The desert. Oh, the arid Southwest. New Mexico, Arizona, Utah and the Rocky Mountains, as well as the Alps, Pacific Equatorial Islands, which I don't know. Maybe that is why we're going to be in Hawaii. Northern -- you've got to turn the page. Northern Australia. And then how about the broad ocean area. That has no particular latitudinal range and that's the Pacific, Atlantic and Indian Ocean. And then the really big one, the atmosphere, which is the atmosphere which envelops the entire earth. That looks to me like a global environmental impact. And it seems to me only fair and some kind of rule that I think is codified in lots of different places that the people that are effected by legislation and -- and programs get to talk about it, get to respond. Well, that is going to be a lot more than the people in the U.S. Even if you say four hearings is enough in the U.S. -- this is a global environmental impact, this Star Wars Program. And, therefore, I'm not impressed with the hearing anymore. I think four is completely minimal.	
Public Involvement	PHO0047-1	Conduct one hearing in the Marshall Islands. After all, that's where the missile testing is taking place.	See previous response.
Public Involvement	PHO0047-2	How come I'm reading here that the request was given to have the hearing posed or made on Kauai, Maui, and the	See previous response.

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		Marshall Islands, and it was refused? These are the most affected places that are going to be most impacted.	
Public Involvement	PHO0048-2	In addition, as everyone has stated, there should be more hearings held. The three on the continent and the one here are just not sufficient.	See previous response.
Public Involvement	PHO0050-2	Finally, I think if it's true that the Missile Defense Agency refused to have public meetings on Kauai where PMRF is and in the Marshall Islands, to me that's a very deep flaw.	See previous response.
Public Involvement	PHO0051-2	And it's amazing to me that you don't have a meeting scheduled in Kauai with almost half of an island impacted by the missile range facility there.	See previous response.
Public Involvement	PHO0058-1	In addition to my own opposition to the proposed ballistic defense system, I come here with words from people who were not offered the opportunity to testify this evening because there was no hearing on the island where they reside and where the impacts will take place.	See previous response.
Public Involvement	PHO0059-1	You really need to hold hearings on Kauai, other places also, but especially Kauai where the Pacific Missile Range Facility is located, who are really greatly impacted by this. And I, too, have friends on Kauai who didn't know about it and want the opportunity to testify.	See previous response.
Public Involvement	E0428-1	The following comments on the environmental and political effects caused by the proposed Ballistic Missile Defense System (MDS) are submitted a day late. I respectfully request that the deadline for submittal of comments be extended for cause. The cause is that there was very little notice to the general public, and only those versed as to the ADAMS or government notice agencies or methods were privy to the proposed invitation to comment.	Comments received through December 1, 2004 are considered in the Final PEIS. Comments received after December 1, 2004 have been included as part of the administrative record; however are not specifically addressed in this response appendix. In addition to the NOA, the MDA developed a publicly accessible web site to provide information on the BMDS PEIS and request comments on the Draft PEIS.

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Public Involvement	PHO0032-1	There's been no widespread publicity in California that we're aware of regarding this hearing today in Sacramento. Is this some sort of the stealth strategy to limit public input on such critical issues. The question is: Can the Draft PEIS be legitimate if there is not adequate notice of the document in the hearings on this matter?	Notification of the public hearings for the Draft BMDS PEIS was released in the NOA, which was published in the FR on September 17, 2004. In addition to the NOA, the MDA placed paid legal notices in the Sacramento Bee (October 13, 2004 and October 16, 2004) and the Lompoc Record (October 13, 2004, October 14, 2004, and October 15, 2004). The BMDS PEIS web site also listed the times and locations of the public hearings.
Public Involvement	PHW0005-1	I am here on behalf of Sacramento Area Peace Action and our 4,000 supporters, both to comment on the PEIS, and to register a complaint with the manner in which this hearing was scheduled. There has been no widespread publicity in California that we are aware of regarding this hearing today in Sacramento. Is this some sort of stealth strategy to limit public input on this crucial issue? We question if a Draft PEIS can be legitimate if there is not adequate notice of the document and the hearings on this matter.	See previous response.
Public Involvement	PHO0046-2	Again, I think that these processes have typically discouraged public participation. Whether that's by design or just by negligence, I think that it needs to be noted that there haven't been adequate efforts to reach out to the public, to provide accessible venues and opportunities for people to testify.	In addition to the public hearings, the MDA developed a publicly accessible web site to provide information on the BMDS PEIS and request comments on the Draft PEIS. The MDA also established toll-free phone and fax lines, an e-mail address, and a U.S. postal service mailbox for submittal of comments and questions. Both the NOA of the Draft PEIS published in the FR and the BMDS PEIS web site provided instructions on submitting comments on the Draft PEIS.
Public Involvement	PHO0046-3	As I said earlier, as Terri Kekoolani said earlier, Hawaiian translation is essential, the native Hawaiian language, Olelo Hawaii, is one of the official languages of Hawaii, and that should be honored in these proceedings so that when Hawaiian words are expressed, they are captured	Attendees at the public hearing were given the opportunity to provide testimony in both Hawaiian and Marshallese languages. A court reporter recorded the proceedings and the audiotapes were later translated by certified translators. Transcripts from the hearings,

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		correctly and not noted as inaudible or unintelligible, which is often the case.	including the translated oral Marshallese and Hawaiian testimony, can be found in Appendix B.
Public Involvement	PHO0046-4	Second, the question of native Hawaiian culture being an oral tradition, it's very important that you provide opportunities for people to give live testimony where they can look you in the eye and express what they are feeling. When you say that often written testimony or e-mail testimony is adequate, you effectively discriminate against a whole group of people who are actually one of the groups that are disadvantaged and should be considered as part of the environmental justice analysis of your Environmental Impact Statement.	Approximately 8,500 comment documents were received on the Draft BMDS PEIS. Comments received via any of the methods identified carry exactly the same weight as comments provided to MDA orally during a public hearing.
Public Involvement	PHO0048-1	First, notice and public hearing were inadequate. Although it's true that NEPA doesn't require them to hold a public hearing, it does require that the notice be on par with the extent of the program. And as they've clearly shown on their beautiful screen, this is supposed to have worldwide effect, yet we're only having, what, thirty of us here? I mean, this is affecting not only all of Hawaii, but all of the pacific and all of the entire world, and where was this hearing noticed in? Was it noticed on TV? Where did you guys hear about it? Word of mouth. I don't think notice was sufficient in this case, especially given the extent of this project.	The PEIS is a programmatic level NEPA analysis that considers implementation alternatives for an integrated BMDS and as such does not address specific sites or specific activities at those sites, but rather considers the program as a whole to allow tiering of subsequent site-specific analyses from the PEIS, as appropriate. The MDA planned to hold its public hearings on the Draft PEIS in the same locations at which scoping meetings were held. Notification of the public hearings for the Draft BMDS PEIS was released in theNOA, which was published in the FR on September 17, 2004. MDA also placed paid legal notices in various newspapers, which are outlined in Appendix B.
Public Involvement	PHO0051-1	First of all, the first comment I want to make has to do with the process. It is very deeply flawed. If what you are planning goes through, then obviously all islands will be impacted. Therefore, to properly inform our people here in Hawaii, you must have all people from all islands being	The PEIS is a programmatic level NEPA analysis that considers implementation alternatives for an integrated BMDS and as such does not address specific sites or specific activities at those sites, but rather considers the program as a whole to allow tiering of subsequent site-specific analyses from the PEIS, as appropriate.

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		fully informed, which would include the Big Island, Maui, Molokai, Lanai, Ni'ihau, and Kauai.	
Public Involvement	PHO0051-3	Also, just alone coming on Oahu, you're having a meeting in a very small hotel, in a small room. The capacity of the room is sixty people.	Based on input provided during scoping, the public hearing location in Honolulu, Hawaii was determined based on availability of parking. The size of the conference room was adequate for the number of attendees.
Public Involvement	PHO0051-4	And so what it looks like is that you're kind of hiding, and that you are not looking for a way to actually get a lot of people to participate in this process.	Approximately 8,500 comment documents were received on the Draft BMDS PEIS during public hearings and via e-mail, mail, phone, and fax throughout the public comment period. The MDA has considered each comment in the development of the Final PEIS.
Public Involvement	PHO0058-2	Finally, I would like also to present the testimony of 1,330 people who signed petitions opposing the expansion of military in Hawaii. And these people need to be included in the process. They need to be notified of the Record of Decision.	MDA appreciates the participation of the petitioners in the BMDS PEIS public comment process. All public comments were taken into account during the preparation of the Final BMDS PEIS and have been included in the administrative record. MDA will place an advertisement in the Honolulu Adviser and the Honolulu Star Bulletin as a Notice of Availability of the Final BMDS PEIS. A copy of the Final PEIS will be posted on the MDA web site: http://www.mda.mil/mdalink/html/mdalink.html. The Record of Decision will be available in the Federal Register no less than 30 days after the publication of the final document.
Site Specific	E0319-3	5. A listing of the Test Sites where target missiles will be launched to be intercepted by the Airborne Laser	Site-specific environmental analyses have been prepared for past MDA activities and will continue to be prepared as appropriate. These future site-specific analyses will tier from this PEIS. Several NEPA documents have been prepared to address proposed activities at the PMRF and consider potential impacts to cultural

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			resources. These analyses include but are not limited to the EIS for the Strategic Target System, the Kauai Test Facility EA, the PMRF Enhanced Capability EIS, and the North Pacific Targets Program EA. Analyses for site-specific MDA actions taking place OCONUS would consider environmental impacts per EO 12114, Environmental Effects Abroad of Major Federal Actions, as well as DoD established Final Governing Standards for environmental compliance requirements for military activities overseas, which take into account the DoD's Overseas Baseline Guidance Document and applicable host-national or international environmental standards. Testing is carried out at appropriate test facilities, ranges and other government installations as determined after considering and evaluating environmental, safety, logistical, cost, schedule, and other technical feasibility issues as well as the test objectives. NEPA analyses of environmental impacts of specific subsequent test activities at sites would be tiered from the PEIS, as appropriate.
Site Specific	E0347-2	The Missile Defense Agency's Programmatic Environmental Impact Statement must acknowledge and include Environmental Impact Assessments for each and every US Missile Defence Base proposed to be sited on land in nations with British or British Commonwealth status, and also in other independent sovereign nations (e.g. Denmark's sovereignty over Thule).	See previous response.

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Site Specific	E0387-1	We are disappointed however that the PEIS will only be undertaken for component bases in the United States and not for overseas bases integral to the system, such as Fylingdales. From our experience of talking to the residents close to the Fylingdales base, we are aware of a constant concern about its role in the "Son of Star Wars" program and a desire for more information and accountability from the developers of the system. The local population in the vicinity of this base has both environmental and security concerns regarding the base's role in Missile Defence that ought to be addressed in such a study. The same also applies for Menwith Hill - considered highly likely to play a key role as the Ground Based Relay Station for the Space Based Infra Red System - and these concerns will grow if the United States is granted permission to use the base for Missile Defence by the UK Government.	See previous response.
Site Specific	E0387-2	Furthermore, there exists a large, informed section of society, not necessarily within the vicinity of these particular bases, that is also legitimately concerned as to the potential impact on UK and global security as a result of the Missile Defence system. Despite the UK's involvement in the system this group too will not be represented by this study.	See previous response.
Site Specific	E0387-3	Despite the fact that the PEIS has currently declared that it will only consider component bases of Missile Defence based in the US, we will refer to the Yorkshire bases both in the hope that the PEIS will recognise the importance of expanding its remit to cover Missile Defence bases beyond the USA mainland, and partly because the	See previous response.

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		concerns that surround these bases can be equally applied to their US-based equivalents.	
Site Specific	F0004-1	1 Take this whole program out to the Aleutian Islands! That's were all this experimental D.O.D. stuff should have been put all along. This is all testing. The Kodiak people + flora + fauna should not be used this way. Take it West to Adak + Shemya where the D.O.D. has been set-up doing "there thing" since prior to WWII! Just by the Adak base back from the Native Corp. (It should have never been sold to them in the first place!) You have all your infrastructure already there too. You can do lots of experiments out there with lil effects on US citizens if done correctly.	See previous response.
Site Specific	F0004-6	5 You do not need to let the AADC gobble-up any-more land to use for this program. The additional 14,000 Acres is our only area on the Kodiak Road System we (the citizens) have that is open for public use. All the other land is private (Native Corps and 3/4 of the Island is in the Kodiak Island National Wildlife Refuge. Please DO NOT take control of these lands. No more land to USE. (the 3,800 Acres you use now is enough. No more ok.	See previous response.
Site Specific	PHO0051-9	That is already taking place right now on Kauai. You folks have missile launching pads over there on top of an ancient burial ground.	See previous response.
Site Specific	PHO0051-10	And also there are now people being denied access to beach fronts that have traditionally always been accessible by our people.	See previous response.
Site Specific	E0319-5	7. If missiles are being proposed for launch from Fort Greeley, Alaska	MDA conducted a preliminary study looking at the technical feasibility of test launching GBIs from Fort Greely in April 2004, but has not yet decided on a proposed test action, thus a NEPA process has not yet

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			begun. Specifically, MDA performed a feasibility study of possible flight trajectories from Fort Greely considering the operationally realistic engagements, target launch sites, and safety. MDA then conducted a range safety assessment of the most feasible GBI trajectories. This study identified three potential flight corridors that if subjected to a more refined and rigorous flight safety analysis could pass range safety standards. Results of this additional study could be used as inputs to MDA's subsequent environmental studies. MDA also is building a Geographic Information System (GIS) to facilitate our analysis by mapping Alaska region data. This GIS analysis will assist MDA planners in developing potential flight test that would be subjected to safety and environmental analysis if MDA considers continuing planning towards a decision for test launches from Fort Greely.
Site Specific	E0319-7	NOTE: Regarding Fort Greeley, Alaska- is the MDA proposing to launch future 'interceptors' in a 'north trajectory' (or south trajectory), over Alaska native villages from that location? If so, the PEIS should list all safety drop-zones for falling booster stages and proposed trajectory launches, along with what safety steps will be taken to protect natives in their villages. Also include potential cumulative environmental damage to the tundra from falling boosters.	See previous response.
Site Specific	E0319-6	8. Information on proposed BMDS launches from Poker Flats Rocket Range, Alaska	At the time this PEIS went to print, there were no planned BMDS launches from Poker Flats Rocket Range, Alaska in the near future. However, should BMDS activities be required at Poker Flats, site-specific

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			environmental analyses would be prepared. These future site-specific analyses would tier from this PEIS.
Site Specific	E0319-9	There has not been an environmental assessment since 2001 (that the public is aware of) regarding the reliability of the STARS missile to justify the continuation of this launch vehicle. The November 2001 STARS launch from the Kodiak Launch Complex resulted in failure (the missile 'exploded' 7 miles off Kodiak's shores after launch and the MDA attempted to cover up the accident). No public reports were released on this launch failure. The STARS missile has not been improved since the early 1990's launch failures from Kwajalein Atoll. This program should be discontinued due to its unreliability, safety hazards, and pollution to air and water.	Testing is carried out at appropriate test facilities, ranges and other government installations as determined after considering and evaluating environmental, safety, logistical, cost, schedule, and other technical feasibility issues as well as the test objectives. This PEIS provides a roadmap for site-specific analyses of the environmental impacts of BMDS activities. There are inherent risks with any missile testing activity; however, protection of life and property, on and off range, is the prime concern of Range/Mission Safety personnel. The RCC Common Risk Criteria for National Test Ranges (RCC 321-02) sets the requirements for minimally acceptable risk criteria to occupational and non-occupational personnel, test facilities and nonmilitary assets during range testing operations. Under RCC 321-02, individuals of the general public shall not be exposed to a probability of fatality greater than 1 in 10 million for any single mission and 1 in 1 million on an annual basis. Range Safety personnel also apply launch window criteria that consider various weather and climatic conditions, as appropriate.
Site Specific	E0319-12	The Alaska Aerospace Development Corporation (a.k.a. Missile Defense Agency) has requested jurisdiction over an additional 14,000 acres of Narrow Cape 'public' land on Kodiak Island, Alaska, over and above the 3,800 acres it already has jurisdiction over. The PEIS should include what type of BMDS testing/activity is being proposed for the Kodiak Launch Complex that would require almost 18,000 acres of public land. Since the request was made	As described in the previous response, protection of life and property, on and off range, is the prime concern of Range/Mission Safety personnel. For this reason, temporary closures of public lands and roads during launch activities may be necessary for safety and security reasons. The Alaska Department of Natural Resources Division of Mining, Land and Water authorized periodic, temporary closures of Narrow Cape in April 2005 after a

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		after the release of the July 2003 Ground-Based Midcourse Defense (GMD)-Extended Test Range FEIS, the reason for the request should have been included in the BMDS Draft PEIS.	thorough public review. The Alaska Aerospace Development Corporation made the request for this ability to close public lands as an additional safety buffer for its own operational reasons; MDA did not make this request. However, if similar issues arise in the future as a result of MDA activities at KLC they will be considered in site-specific documentation tiered as appropriate from this PEIS. The MDA understands the sensitivity of closing public lands even for a short period and every effort would be made to ensure that such closures do not create undue burden on local residents.
Site Specific	E0319-15	Kodiak Launch Complex and Kodiak Island issues that should have been discussed in detail in the BMDS Draft PEIS are: 1. Island-wide areas that will be evacuated for BMDS activity 2. Health and Safety procedures for exposure to launch debris-especially for potentially affected populated native villages such as Old Harbor and Akhiok 3. Doing a site-specific operating document (referred to in Volume 2, page H-13) 4. The potential electromagnetic explosive devices, ionizing and non-ionizing radiation hazards 5. Hazards and trajectories of interceptors 6. Special Use Airspace and Domestic Warning Areas	As stated throughout the PEIS, this document is intended to serve as a tiering document from which future site-specific NEPA analyses will be tiered. These analyses can consider the potential impacts of specific safety plans and trajectories of interceptors for individual tests. Section 4.1.1.2 of this document provides an overview of Health and Safety Procedures, special use airspace and warning areas, as well as potential impacts of the use of missile launches.
Site Specific	E0319-16	'Generally, sites where activities for the proposed BMDS activities may occur are located far from towns and population centers and are surrounded by open space' (PEIS Volume 2, page H-14). This does not apply to the Kodiak Launch Complex. The test site is located only a few miles from a populated and State of Alaska	Existing site-specific environmental analyses for activities at Kodiak Launch Complex (KLC) include the GMD ETR EIS, the EA for USAF Atmospheric Interceptor Technology Program, the Final EA for USAF Quick Reaction Launch Vehicle Program, the North Pacific Targets Program EA and the FAA EA for the

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		recreational area. Cabins, homes, bed and breakfast accommodations are located near the Pasagshak River, which is highly frequented by fishermen and tourist during summer months, and hunters and recreational users during the winter months. Cabins and homes are in year-around use in the winter unless the roads are impassable due to snow coverage. However, this is not expected to be a problem since the road to the launch site has to be accessible to workers (especially in preparation for an upcoming launch). The PEIS needs to discuss proposed BMDS activity on Kodiak Island in detail.	KLC, Kodiak Island. Further, the PEIS is intended to provide a programmatic analysis of the potential impacts associated with the development, testing, deployment, and decommissioning of the BMDS. The PEIS is not a site or component specific environmental analysis, and therefore does not provide specific information about particular components or their operation at various facilities. As specific test requirements become known NEPA analyses will be prepared, appropriately tiered from this PEIS.
Site Specific	E0319-11	The PEIS should include all proposed laser test sites including the BOA, and, what experiments will take place at each site, and the total amount of acreage needed as a safety zone. For example, will the Airborne Laser 'test fire' at targets or interceptors launched from Vandenberg AFB, Kwajalein, Kodiak Island, Fort Greeley, or Poker Flats Rocket Range, Alaska?	The MDA process for selecting BMDS test locations is based upon criteria developed by the MDA system engineering team (e.g., Systems Engineering and Force Structure Integration and Deployment, and the Elements) to include engagement sequence groups, system test objectives, and overall system design. The team develops a System Event Test Program based on simulation models, pre-test analysis, post-test evaluation (verification of objectives) and produces a requirements matrix for each Test Bed Block. The test requirements are tailored to the availability and capability of test assets and the configuration constraints imposed by the test ranges. From the Test Bed Block Matrix, test objectives and range requirements are derived for each BMDS test event which undergoes a formal coordination process. SE delivers the final test objectives and range requirements to the Combined Test Force (CTF) for execution.

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			The CTF, through the PRST, assists the program element/mission test director in further defining the required range support. The PRST consolidates the personnel resources, range assets and instrumentation and capabilities necessary to efficiently conduct end-to-end BMDS-level flight testing in the Pacific. The PRST then recommends the test range(s) best suited to achieve the test objectives.
Site Specific	E0347-1	Crucial to the US Missile Defence programme is the stationing of 'forward surveillance' facilities located outside the continental USA at US Bases on land it is permitted to use by host nations. The political structure of such nations may be very different from the Federal Government (e.g. Britain is a Monarchy: q.v. 'Crown Defence Land'). The legislation regulating environmental controls in other countries may be very different, possibly more stringent, than that which obtains within the USA. It is incumbent on the Missile Defense Agency to apprise itself of, and publish an undertaking to comply with, mandatory statutory requirements wherever on the Earth it proposes to site Missile Defence facilities.	The PEIS analyzes the programmatic development, testing, deployment, and planning for decommissioning activities for an integrated BMDS. Site-specific actions would be analyzed in subsequent NEPA analyses that would tier from this document, as appropriate. Analyses for site-specific MDA actions taking place OCONUS would consider environmental impacts per EO 12114, Environmental Effects Abroad of Major Federal Actions, as well as DoD established Final Governing Standards for environmental compliance requirements for military activities overseas, which take into account the DoD's Overseas Baseline Guidance Document and applicable host-national or international environmental standards.
Site Specific	E0427-29, E0439-29	26) Which government and university institutions in the State of California will be conducting research to support the BMDS research and development and, if so, please describe their roles, responsibilities and the specific projects they will be involved in? Specifically, will Lawrence Livermore National Laboratory, Lawrence Berkeley National Laboratory, Sandia National Laboratory - Livermore, or the University of California at Berkeley, Davis or Los Angeles be conducting research or development on the BMD for the MDA or DoD and, if so,	The PEIS analyzes the programmatic development, testing, deployment, and planning for decommissioning activities for an integrated BMDS. Specific facilities that would be used to carry out subsequent activities comprising the life cycle phase testing would be analyzed in site-specific documents. These subsequent NEPA analyses could tier from this PEIS as appropriate.

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		what specifically will each that is involved be doing? This is important for people in these areas to know in order to understand, consider and evaluate the possible environmental, health, and safety impacts on their communities.	
Site Specific	F0004-2	1 The planned rocket trajectories that go over Kodiak Island + skirt very close to the East Side are just totally unacceptable! We have to many Native Villages + Bush people who live there year round. NOT to mention all the wildlife (Bears! Rare Kodiak Brown Bears!) that live there too. It is just to damn dangerous to launch over the Island. Period! That can NOT proceed	As stated in Section 4.1.1.2, Health and Safety, launch activities would be conducted when trajectory modeling verifies that launch-related debris would be contained within predetermined areas, all of which would be located away from populated areas.
Tiered Analyses	E0429-11	Waiting for site-specific analysis in the indefinite future condemns project sites to acid precipitation. There is no hint of how such an environmental impact might be mitigated. The proper analysis, at this stage, is to consider how the missile defense program might develop and test alternate launch technologies that are not so environmentally destructive. That is, the best solution is not likely be site-specific, so the PEIS itself should evaluate this impact.	The BMDS PEIS considers the use of a wide variety of propellants including three types of boosters, pre-fueled liquid propellant, non-pre-fueled liquid propellant, and solid propellant boosters. The environmental impacts of each of these three types of boosters have been considered and are presented in Section 4.1.1.2 of the PEIS. However, it is appropriate to analyze the potential impacts of launching specific test vehicles from particular sites in subsequent tiered site-specific NEPA documentation, and the MDA will consider the environmental impacts of conducting test launches in such documentation, as appropriate.
Tiered Analyses	PHW0004-11	Waiting for site-specific analysis in the indefinite future condemns project sites to acid precipitation. There is no hint of how such an environmental impact might be mitigated. The proper analysis, at this stage, is to consider how the missile defense program might develop and test alternate launch technologies that are not so environmentally destructive. That is, the best solution is	See previous response.

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		not likely be site-specific, so the PEIS itself should evaluate this impact.	
Tiered Analyses	E0429-21, PHW0004-21	Overall, the PEIS puts off consideration of the challenge of waste decommissioning, stating, "The environmental impacts associated with decommissioning of specific components would be more appropriately addressed in subsequent tiered environmental analysis..." (ES-20) This is unacceptable. It can only lead to "end-of-pipe" solutions, even though the Defense Department's own environmental managers and specialists agree that environmental protection should be integrated into acquisition and even research and development. The 2001 Munitions Action Plan, for example, states: The current emphasis in acquisition of munitions of all types (air delivered, ground launched, and sea launched) is on improving accuracy, reliability and increasing distances between firing or launch points and targets (i.e., so-called standoff ranges). At the same time, the public and regulatory bodies are raising concerns about safety and the environmental effects of munitions. The DoD is also becoming more aware of the cleanup and environmental compliance costs associated with training, testing, demilitarization, and unexploded ordnance (UXO) responses. These developments have highlighted the need for DoD to address environmental and safety concerns, and costs, throughout the munitions life cycle. This cycle starts from the technology development and design phase to the end-	Section 4.0 of the PEIS provides a roadmap for considering impacts of decommissioning for each component. However, as stated in the BMDS PEIS, the environmental impacts of demilitarization and disposal are more appropriately considered in subsequent tiered analyses. The MDA is actively engaged in considering and evaluating ways to minimize environmental impacts in the design, test, and development of the BMDS. Specifically Appendix M of the PEIS considers the demilitarization, reclamation, declassification and disposal of solid rocket propellant.

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		state of use, UXO and munitions constituents cleanup on ranges, or demilitarization. Addressing these concerns early in the life cycle (during requirements definition and acquisition) has the potential to significantly reduce costs and avoid problems later. [Footnote 16: Munitions Action Plan: Maintaining Readiness through Environmental Stewardship and Enhancement of Explosives Safety in the Life Cycle Management of Munitions, U.S. Department of Defense Operational and Environmental Executive Steering Committee for Munitions (OEESCM), November 2001, page 16.] That is, if the review of the potential environmental impacts of a system such as the BMDS finds the potential for significant negative environmental impacts, then those designing the system, selecting programmatic alternatives, and managing its testing and deployment should continuously evaluate ways to minimize those impacts, from the beginning.	
Tiered Analyses	F0005-13	II. The draft PEIS fails to analyze what would be required to develop a space-based test bed; dismissing the suggestion as "too speculative." But that is precisely what the PEIS is supposed to - to examine the environmental effects of the proposed action. Accordingly, the draft PEIS is flawed for not looking at the effect of space-based interceptors in lieu of terrestrial-based ones - it simply suggests that future studies may be required. This dismissive attitude toward NEPA would not survive judicial scrutiny.	Alternative 2 includes the use of weapons from land-, sea-, air-, and space-based platforms. The use of space-based weapons is analyzed in Section 4.2; specifically, Section 4.2.1 analyzes the use of interceptors, including the impacts from launch/flight and debris, from a space-based platform. However, as stated in the PEIS the analysis of a space-based test bed is not mature enough for NEPA analysis at this time.
Tiered Analyses	F0005-19	(5) The PEIS should review the testing, of future laser weapons systems and specify testing plans for other high-	Appendix F of this PEIS describes various advanced systems that are currently under review by the MDA.

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		power laser weapons and other energy-directed weapons. It does not.	The PEIS is intended to provide a programmatic analysis of proposed BMDS activities. The PEIS considers the potential impacts of the BMDS as currently envisioned. Specific testing programs of undeveloped directed energy weapons are not yet known and cannot be analyzed in environmental analyses. As the technology for these programs matures and the MDA develops testing scheduled for such advanced directed energy weapon systems, appropriate environmental analyses will be conducted.
Tiered Analyses	M0268-1	The MDA knows at present from where ground based interceptors will be launched, and site specific studies should be absolutely required in the PEIS.	The MDA analyzed the impacts of constructing and operation of GBI sites at Vandenberg AFB in the GMD Vandenberg Air Force Base IDOC EA and at Fort Greely in the GMD Validation of Operational Concept (VOC) EA. The PEIS is a programmatic analysis and is intended to serve as a tiering document for future site-specific analyses. Future actions involving the construction and operation of interceptors from specific locations would be addressed in subsequent site-specific analyses tiered from the PEIS as appropriate.
Tiered Analyses	M7903-1	My perspective is that of a long time resident of Interior Alaska familiar with the Fort Greely area where one of the missile sites is currently under development. Unfortunately, the selection of this site was not adequately evaluated in relation to the environmental sensitivity of this area. Inadequate consideration was given to the fact that the site sits on top of the flowage of a unique aquifer that flows through the glacial outwash gravels from the Alaska Range mountains to the south, under Fort Greely, and emerges as springs that feed the Delta Clearwater River and lake system. Because of the upwelling water of	The MDA analyzed the activities at Fort Greely in the GMD VOC EA. The PEIS is a programmatic level analysis that addresses the implementation alternatives for an integrated BMDS and as such does not consider specific sites or activities at specific sites. Any future site-specific activities occurring at Fort Greely or other sites in Alaska would consider potential environmental impacts from spills of contaminants or fuels in subsequent tiered analyses, as appropriate.

Exhibit K-5. Response to Comments – Proposed Action and Alternatives

Issue Topic	Comment Number	Excerpt Text	Response
		the Delta Clearwater system it is one of the most productive salmon spawning complex and young salmon rearing area on the entire Yukon-Tanana River system. Any significant leakage or spill of contaminants, inclusive of fuels, and radioactivity contaminated water or other materials would have the potential for devastation to both the commercial and subsistence fisheries of the Yukon River and [sic] Bering Sea through direct affects on the fish, as well as the thousands of people dependent upon the fish for their nutrition, health, and economy. Additional studies need to be done to assess this potential threat to the Alaska environment and its people and to assess the possible need for mitigative planning, spill contingency development, and testing for background leakage levels from the post World War II use of Fort Greely as a biological and chemical warfare testing site.	
Tiered Analyses	PHO0038-3	I'm really concerned about the aborted launch that happened at Kodiak, I believe it was two years ago November and Kodiak itself is a significant enough population center to be concerned about it, but if we start launching missiles from Fort Greeley, which is near Fairbanks, near Delta Junction, that have to be aborted, there's significant population centers there, not to mention the TransAlaska Pipeline.	The PEIS is a programmatic level analysis that addresses the implementation alternatives for an integrated BMDS and as such does not consider specific sites or activities at specific sites, such as the KLC or Fort Greely. Prior activities have been analyzed in NEPA analyses as cited in the PEIS. Future activities would be analyzed in subsequent tiered analyses. In addition, as stated in Section 4.1.1.2, launch hazard areas would be determined before a test launch is conducted from a site. Potential impact zones for launch debris would be delineated based on detailed launch planning and trajectory modeling. Flights would be conducted when trajectory modeling verifies that launch-related debris would be contained within predetermined areas, all of which would be located away from populated areas.

Exhibit K-5. Response to Comments – Proposed Action and Alternatives

Issue Topic	Comment Number	Excerpt Text	Response
Tiered Analyses	PHO0038-4	It's unclear from the PEIS, and I'm looking at Section 2.242, whether or not the Kodiak Launch Complex is going to be a launch test and defensive operational asset or if it's going to launch things into orbit, or if it's just a test center. So it's confusing for the folks on Kodiak and for us here in Alaska what is actually going to happen out on the island. It talks about a safety zone that would be established around the laser during activation. This is also in the PEIS, Pages 250 to 254. There's a lot of small plane traffic and a lot of small boat traffic around Kodiak and other places in Alaska. It has us concerned about the laser and its effects on our economy and on the human resources, or humans, I should say, of Alaska.	The PEIS is a programmatic environmental analysis. The PEIS does not consider the testing or operation of specific components at specific locations. The KLC is currently licensed by the FAA to conduct up to nine launches of vehicles weighing less than 500,000 pounds total with SRM primary stages with less than 369,000 pounds of Class I, Division 3 explosives. If additional launches in support if MDA testing were proposed, these activities could be analyzed in subsequent analysis tiered from the PEIS. In addition, the impacts to plane and boat traffic in Kodiak from the establishment of a safety zone for potential future laser activities would be analyzed in additional NEPA documentation, as necessary.
Tiered Analyses	PHW0002-3	This draft PEIS also does not look at what would be required to develop a space-based test bed, dismissing the concept as being "too speculative to be analyzed in this PEIS." (p. 2-29) It does not say when such a concept would be analyzed. Finally, this document admits, "If Alternative 2 were selected, additional environmental analysis could be needed as the technologies intended to be used became more defined and robust." (p. 4-116) But again, that is what this document is supposed to do: examine the environmental effects of the proposed action. By sweeping it under the nebulous responsibility of future studies, it relieves the MDA of liability of negative consequences stemming from SBIs.	The PEIS analyzes the use of space-based weapons as discussed in Section 4.2. Specially, Section 4.2.1 analyzes the use of interceptors, including the impacts from launch/flight and debris, from a space-based platform. However, as stated in the PEIS the analysis of a space-based test bed is not mature enough for NEPA analysis at this time.

K.5 Federal Agency Comment Documents

This section addresses comment documents submitted by Federal Agencies. All comment documents submitted by Federal Agencies are reproduced in Section K.5.1. Responses to specific comments submitted by Federal Agencies are provided in Section K.5.2. Section K.5.2 includes the comment document number and sequential number of the comment, the resource area addressed by the comment, the text of the comment, and MDA's response. Where appropriate, revisions to the Final BMDS PEIS were made in response to these comments.

K.5.1 Reproductions of Federal Agency Comment Documents

DC_E0403

Johnson, Kathryn

From: Ramona Schreiber [Ramona.Schreiber@noaa.gov]
Sent: Wednesday, November 17, 2004 4:09 PM
To: mda.bmds.peis
Subject: NOAA Comments on Draft BMDS PEIS

Ramona.Schreiber.vcf (441 B)

Dear Project Manager:

The National Oceanic and Atmospheric Administration is composing its comments on the Draft BMDS PEIS. As a thorough review under the Magnuson Stevens Act Essential Fish Habitat requirements, Endangered Species Act, and Marine Mammal Protection Act is involved, our comments may be delayed. We anticipate providing them within the week. Please accept them in that format as we are a Federal partner of yours.

Thank you in advance,
Ramona Schreiber

DC_F0003

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF ENFORCEMENT AND COMPLIANCE ASSURANCE

November 17, 2004

Missile Defense Agency
Ballistic Missile Defense System PEIS
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Dear Mr. Lehner:

In accordance with our responsibilities under Section 309 of the Clean Air Act and the National Environmental Policy Act (NEPA), the Environmental Protection Agency (EPA) has reviewed the Missile Defense Agency's (MDA) Ballistic Missile Defense System (BMDS) Draft Programmatic Environmental Impact Statement (DPEIS) (CEQ # 040438).

The DPEIS identifies, evaluates and documents, at the programmatic level, the potential environmental impacts of activities associated with the development, testing, deployment, and planning for the eventual decommissioning of the BMDS. It considers the current technology components, support assets, and programs that make up the proposed BMDS as well as the development and application of new technologies.

EPA commends the efforts that MDA has commenced in producing such a comprehensive and well organized document. We also appreciate your efforts in utilizing the extensive environmental analysis that is available for many of the existing components of the proposed BMDS. Based on our review of the DPEIS, we have rated the document as LO - Lack of Objections (see attached "Summary of EPA Rating System"). Although EPA has no objections to the proposed action, there are a few issues that should be clarified.

DC_F0003

1) General Comments:

a. To assess the impacts of implementing the proposed BMDS, the DPEIS characterized the existing condition of the affected environment in the locations where various BMDS implementation activities are proposed to occur. MDA has determined that activities associated with the proposed BMDS might occur in locations around the world. Therefore, the affected environment has been considered in terms of global biomes, broad ocean areas, and the atmosphere. This has resulted in the DPEIS being very conceptual and general in nature. EPA understands that once potential BMDS locations are determined, more detailed site-specific documents will be prepared. Through the discussions on the "block approach" or the "block development process", the DPEIS has given clear indications of when follow-on NEPA analysis will occur. We agree with this approach. However, while the documents give representative examples of past, current, or proposed locations where proposed activities may occur within each biome, EPA recommends that the EIS discuss the criteria that MDA will use in making future decisions for site-specific locations.

b. The resource areas considered in this analysis are those resources that MDA believes can potentially be affected by implementing the proposed BMDS. EPA agrees that some resource areas are site-specific or local in nature and, therefore, cannot be effectively analyzed in this type of programmatic document and that the potential impacts on these resources are more appropriately discussed in subsequent site-specific documentation tiered from this PEIS. However, EPA recommends that the final document discuss the existence of multiple species habitat conservation planning efforts that are proximate to DoD lands and the potential impacts of debris on marine and aquatic ecosystems.

c. As suggested by CEQ regulations, MDA has taken advantage of the extensive environmental analyses that already exist for many of the existing components of the proposed BMDS by incorporating these materials into the DPEIS by reference. However, some of these documents are greater than 10 years old. The PEIS should confirm the validity of the information in these documents.

2) Perchlorate Comment: Because there have been differing interpretations of the science associated with the impact on human health from low level exposure to perchlorate and in the interest of resolving scientific questions, EPA, the Department of Defense, the Department of Energy, and the National Aeronautics and Space Administration - members of a broader Interagency Working Group on Perchlorate led by the Office of Science and Technology Policy - have referred scientific issues and EPA's 2002 Draft Health Assessment on Perchlorate to the National Academy of Science (NAS) for review. NAS is currently conducting a study to determine the best science and model to use for determining the health impacts and standards for perchlorate. A report on this study is expected to be completed by the end of 2004. EPA recommends that the results of the report be incorporated into the FPEIS.

DC_F0003

We appreciate the opportunity to review this DPEIS. We also look forward to reviewing the FPEIS related to this project. The staff contact for the review is Marthea Rountree and she can be reached at (202) 564-7141.

Sincerely,

for

Anne Norton Miller
Director
Office of Federal Activities

Enclosure: Summary of Rating Definitions

DC_F0003

SUMMARY OF EPA RATING SYSTEM

Rating the Environmental Impact of the Action

- **LO (Lack of Objections)** The review has not identified any potential environmental impacts requiring substantive changes to the preferred alternative. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposed action.
- **EC (Environmental Concerns)** The review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact.
- **EO (Environmental Objections)** The review has identified significant environmental impacts that should be avoided in order to adequately protect the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). The basis for environmental objections can include situations:
    1. *Where an action might violate or be inconsistent with achievement or maintenance of a national environmental standard;*
    2. *Where the Federal agency violates its own substantive environmental requirements that relate to EPA's areas of jurisdiction or expertise;*
    3. *Where there is a violation of an EPA policy declaration;*
    4. *Where there are no applicable standards or where applicable standards will not be violated but there is potential for significant environmental degradation that could be corrected by project modification or other feasible alternatives; or*
    5. *Where proceeding with the proposed action would set a precedent for future actions that collectively could result in significant environmental impacts.*
- **EU (Environmentally Unsatisfactory)** The review has identified adverse environmental impacts that are of sufficient magnitude that EPA believes the proposed action must not proceed as proposed. The basis for an environmentally unsatisfactory determination consists of identification of environmentally objectionable impacts as defined above and one or more of the following conditions:
    1. *The potential violation of or inconsistency with a national environmental standard is substantive and/or will occur on a long-term basis;*
    2. *There are no applicable standards but the severity, duration, or geographical scope of the impacts associated with the proposed action warrant special attention; or*
    3. *The potential environmental impacts resulting from the proposed action are of national importance because of the threat to national environmental resources or to environmental policies.*

Adequacy of the Impact Statement

- **Category 1 (Adequate)** The draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.
- **Category 2 (Insufficient Information)** The draft EIS does not contain sufficient information to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the proposal. The identified additional information, data, analyses, or discussion should be included in the final EIS.
- **Category 3 (Inadequate)** The draft EIS does not adequately assess the potentially significant environmental impacts of the proposal, or the reviewer has identified new, reasonably available, alternatives, that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. The identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. This rating indicates EPA's belief that the draft EIS does not meet the purposes of NEPA and/or the Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS.

DC_F0006

Program Planning & Integration
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
13155 East West Highway
SSMC-3
Silver Spring, MD 20910

Assistant Administrator
Mary Glackin - 301-713-1632

Acting Director, Strategic Planning Office
James H. Butler – 301-713-3318
FAX: (301) 713-0585 or
(301) 713-3324

TO:	MDA BMDS PEIS c/o ICF CONSULTING	**FROM:**	RAMONA SCHREIBER
		Tel.:	301-713-1622 x190
FAX:	877-851-5451	**Number of Pages:** (including cover sheet)	4

MESSAGE:

NOAA COMMENTS ON BMDS PEIS

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

NOV 17 2004

MDA BMDS PEIS
C/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Dear Project Leader:

Thank you for the opportunity to review the Missile Defense Agency Ballistic Missile Defense System Programmatic Environmental Impact Statement. On behalf of the National Oceanic and Atmospheric Administration (NOAA), provided here are comments developed by NOAA's National Marine Fisheries Service (NOAA Fisheries). NOAA's responsibilities include conservation of resources under the Magnuson-Stevens Act Essential Fish Habitat provisions, Endangered Species Act, and Marine Mammal Conservation Act.

Should you have questions and when you are ready to consult further with NOAA regarding requirements under the above statutes, please contact the NOAA Fisheries Southwest Regional Office at 562-980-4000.

Sincerely,

Ramona Schreiber
For Susan A. Kennedy
Acting NEPA Coordinator

Attachment

NOAA Fisheries Southwest Region's comments for inclusion in a NOAA response for the Missile Defense Agency's proposed Ballistic Missile Defense System

The Southwest Region, National Marine Fisheries Service (SWR) has reviewed the September 1, 2004, draft Programmatic Environmental Impact Statement (draft PEIS) for the Missile Defense Agency's proposed Ballistic Missile Defense System (BMDS). The purpose of the proposed action is for the Missile Defense Agency to incrementally develop and field a BMDS that layers defenses to intercept ballistic missiles of all ranges in all phases of flight. The BMDS is proposed to be a layered system of defensive weapons that have the potential to impact particular trust resources of NOAA during activities associated with the development, testing, deployment, and planning for decommissioning of the BMDS. This memo letter the SWR's comments on the proposed action under purview of the Essential Fish Habitat (EFH) provisions in the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S. C. 1855, *et. seq.*), and protected resource provisions in the Marine Mammal Protection Act (16 U.S.C. 1361 *et. seq.*), and the Endangered Species Act (16 U.S.C. 1531 *et. seq.*).

Essential Fish Habitat Conservation Recommendations
Pursuant to 16 U.S.C. § 1855(b)(2) of the Magnuson-Stevens Act, Federal agencies are required to consult with the Secretary of Commerce (delegated to NOAA Fisheries) with respect to "any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any essential fish habitat identified under this Act." In addition, the Magnuson-Stevens Act also requires the Secretary of Commerce recommend to the federal action agency particular measures that can be taken by such agency to conserve fish habitat (16 U.S.C. § 1855(b)(4)(A).

This consultation involves the EFH of anadromous and marine species managed by the Pacific Regional Fishery Management Councils within the Exclusive Economic Zone of the United States for the Pacific Salmon Fishery Management Plan (FMP), the Coastal Pelagic Species FMP, the Pacific Groundfish FMP, and the Highly Migratory Species FMP. These species utilize various habitats that include riverine, estuarine, and marine systems and these habitats may be adversely affected by some of the activities associated with the development, testing, deployment and planning for decommissioning of the BMDS. Primarily, the agency is concerned about potential release of hazardous materials (e.g., chemicals, propellants, propellant by-products, launch emissions) that potentially could be released directly and indirectly to the habitat types listed above during various phases of the BMDS. In order to minimize these potential impacts, the SWR advises the following:

1. NOAA Fisheries recommends that the Missile Defense Agency be responsible for handling and disposing of all hazardous materials or hazardous wastes in all phases of the proposed action in accordance with applicable Federal, state, and local laws, utilizing best management practices at all life cycle activities of the proposed action and through appropriate project planning and design measures including appropriate spill prevention, control and contingency plans (e.g., Oil Discharge Prevention and Contingency Plan, Storm Water Pollution Prevention Plan) for each site.

Endangered Species Act

Based on the information provided in the draft PEIS, NOAA Fisheries recommends that the Missile Defense Agency consult with the appropriate NOAA Fisheries Regional Office to determine if listed species under the Endangered Species Act (ESA) of 1973 as amended (16.U.S.C. 1531 *et. seq.*) may be affected by the proposed project. If it is determined that this project may affect a listed or proposed species, the Missile Defense Agency should request initiation of consultation with NOAA Fisheries pursuant to section 7 of the ESA.

Marine Mammal Protection Act

Whales, dolphins, seals, and sea lions are protected under the Marine Mammal Protection Act (MMPA). Under the MMPA, "take" of a small number of marine mammals is permitted by NOAA Fisheries under an Incidental Harassment Authorization (IHA) when the specified activity is incidental, but not intentional. "Take" is defined as harassing, hunting, capturing, or killing, or attempting to harass, hunt, capture, or kill any marine mammal. "Harassment" is defined as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal in the wild, or has the potential to disturb a marine mammal in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. Based on the information included in the draft PEIS, the proposed project may cause take of marine mammals under the jurisdiction of NOAA Fisheries. NOAA Fisheries recommends that the Missile Defense Agency consult with the appropriate NOAA Fisheries Regional Office when conducting the site-specific analyses for potential impacts to marine mammals.

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, DC 20240

TAKE PRIDE IN AMERICA

NOV 18 2004

ER 04/701

MDA BMDS PEIS
C/O ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Ladies/Gentlemen:

The United States Department of the Interior has reviewed the Department of the Defense, Missile Defense Agency's (MDA) draft programmatic environmental impact statement (DPEIS) for the Ballistic Missile Defense System (BMDS) and offers the following comments.

Air Quality and Pollution

The Department's National Park Service (NPS) commends the MDA for recognizing that review requirements under the National Environmental Policy Act (NEPA) are not the same as those involving conformity and its willingness to comply with both NEPA and the conformity regulations. The Department also commends the MDA for examining potential impacts on air quality, including its recognition of visibility as an important issue, and looks forward to future reports that include an examination of visibility impacts.

Section 3.1.3 Biological Resources

Pages 3-16 to 3-17: The portion titled "Definition and Description" emphasizes consideration of Federal and State listed species, or species proposed for listing. However, NEPA requires that other species that may be impacted by the proposed activity must also be evaluated throughout the DPEIS. See also page 4-42, subportion "Launch/Flight Activities," where impacts to only species of concern are addressed. We recommend that the DPEIS address all applicable species.

Pages 3-17 to 3-18: In the portion titled "Impact Assessment," we recommend the following text be inserted to address requirements in the referenced laws:

> If the proponent of the proposed activity determines that migratory bird species may be adversely impacted, then the proponent should confer with the Department's Fish and Wildlife Service's (FWS) Regional Migratory Bird Program to ensure

> compliance with the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act, where applicable. Under the MBTA, the taking of migratory birds is not authorized without a permit. The project proponent should also confer with the Service to determine if conservation measures may be implemented to minimize or avoid take of migratory birds.

Page 3-19: In the subportion "Determination of Significance," we recommend that reference to the MBTA be incorporated. We also recommend that the final PEIS indicate that military readiness activities implemented in the future by the MDA should be in compliance with the rule currently being finalized by the Service, "Migratory Bird Permits: Take of Migratory Birds by DoD."

Section 3.1.9 Land Use

Page 3-31: In the portion titled "Impact assessment," we suggest referencing the Service National Wildlife Refuges.

Section 4.1.1.1 Weapons – Lasers

Page 4-26: In the portion titled "Biological Resources," under the subportion "Land and Sea Operating Environments," we recommend adding text that indicates that hydrochloric acid could have an effect on shorebirds and waterbirds (in addition to waterfowl, which are already referenced).

Page 4-27: In the last paragraph under the subportion referenced above, we recommend that the text specify the maximum noise level, if available, for which animals "generally return to normal activities within a short time following noise disturbance." Most wildlife has a limited tolerance to noise. We recommend specifying the threshold at which this tolerance level would generally be exceeded and when adverse effects may occur. See also page 4-43 where impacts to birds from noise disturbance are discussed in greater detail. These two sections should be in agreement with each other. The statement on page 4-27 is not in concurrence with the discussions on page 4-43, which indicate there may be more than minor disturbances.

Section 4.1.1.3 Sensors – Radars

Page 4-64 to 4-65: We believe the analysis of impacts on birds from radar in the "Biological Resources" portion is outdated and inadequate. The first paragraph of this portion does not address the potential effects of radar on very large flocks of migrating birds. Even if a bird is not "within the most intense area of the beam for any considerable length of time," there is insufficient evidence to support the statement that no significant adverse impacts to birds would occur. The 1993 report that is referenced to support this conclusion is outdated.

We recommend the analysis describe what constitutes a "relatively small" beam size. A beam going through a dense flock could have an adverse effect on birds, particularly for those species which are already significantly in decline. We recommend that this potential adverse effect be described.

We recommend that this section discuss the potential of using NEXRAD (Next Generation Weather Radar) to help evaluate when large flocks may be in the testing area. NEXRAD could provide valuable information regarding times when testing should not occur to reduce biological impacts. This technology is currently being used by the Air Force to reduce the potential for air strikes and by the Department of Defense to identify important stopover habitat in relation to Department of Defense installations.

We recommend that an avian physiologist, particularly one very knowledgeable of electromagnetic radiation, carefully review the effects of this proposed activity.

In reference to the Cobra Dane study, it should be noted in the DPEIS that arctic foxes, which are very efficient predators, are present on Shemya and other Aleutian Islands, and would quickly remove evidence of any bird kills. Lack of evidence of bird die-offs under these conditions does not provide solid evidence that they aren't occurring.

Bird collisions with radar equipment, particularly towers, can have significant impacts on birds. Estimated annual bird kills from collisions with communication towers (radio, television, cellular, and microwave) range from four- to five-million, both from direct collisions with the towers themselves and with guy wires. Tall radar towers, i.e., those above 199 feet MSL (mean sea level), are of particular concern. The greatest impact occurring from towers illuminated at night with solid or pulsating incandescent red lights. In addition, the potential for tower collisions significantly increases at night under cloudy or otherwise low visibility conditions.

Because of these impacts, the MDA should follow the FWS's "Interim Guidelines For Recommendations On Communications Tower Siting, Construction, Operation, and Decommissioning - 2000," for both existing and proposed radar towers. These guidelines should be referenced in the DPEIS as applying to radar equipment. They also should be applied to Re-Radiation Towers discussed in the second paragraph on page 4-77.

Section 4.1.1.5 Sensors - Laser Sensors

Page 4-73: Under the portion titled "Biological Resources," we have similar concerns for potential impacts on migratory birds from laser sensors as those stated above for radar equipment. This is particularly true for the use of land and sea-based lasers and in situations where large flocks may be present. Although the lasers may not directly hit birds or other wildlife on the ground, impacts to birds in the air could be significant. We recommend that these potential impacts be described.

Regarding the Nominal Ocular Hazard Distance, the DPEIS concludes that impacts to wildlife from a space-based laser sensor would be insignificant because it is unlikely that the laser would be directed towards the Earth's surface and, if it were, distortion from atmospheric conditions would reduce the radiance level. It further concludes that the Earth's surface would likely be beyond the Nominal Ocular Hazard Distance. This conclusion is not well supported. We recommend that the DPEIS identify how "likely" it is that the Earth's surface would not be beyond this specified distance.

Section 4.1.1.9 Support Assets - Infrastructure

Page 4-89 to 4-90: In reference to the first paragraph under "Biological Resources," we note that the construction of infrastructure, depending upon its extent, can significantly increase surface runoff. This can negatively impact surrounding habitats, particularly wetlands and other sensitive habitats. Impacts to fish, wildlife, and plants from pollutants could be more than temporary depending upon the pollutant and length of exposure. Depending upon the species in the project area, construction could have a larger area of disturbance than 50-feet, particularly for nesting bird species. We recommend that this section describe these possible impacts.

We recommend that the second paragraph indicate that site preparation and installation could negatively impact waterbirds utilizing the shore environment, particularly during breeding season.

In the third paragraph, we recommend that the description of behavioral responses to construction include nest abandonment and alteration of migration routes of larger mammals.

We recommend that the fifth paragraph list compliance with the Marine Mammal Protection Act, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act as required, where applicable. These regulatory references should also be inserted in the portion titled "Biological Resources" under Section 4.1.1.10 Support Assets - Test Assets.

Section 4.1.2.3 Biological Resources

Page 4-105: Under "Integrated Ground Tests," we believe that the conclusion of insignificant impacts is not sufficiently justified or supported. This section lacks information regarding the size and orientation of the operating radar sensors. It also does not describe the anticipated increased number of these operating radar sensors.

Section 4.4 Adverse Environmental Effects That Cannot Be Avoided

Page 4-133: As stated above, we believe that statements of no significant impact are not sufficiently justified or supported. This section indicates Best Management Practices would be implemented to mitigate adverse effects. However, the DPEIS does not provide sufficient information regarding what these measures might be or what would be recommended. In addition, the conclusion that "those [effects] that could not be avoided should not result in a significant impact to the environment" could be viewed as arbitrary since those effects are insufficiently described.

Appendix H Biome Descriptions

Page H-106: We suggest expanding the discussion of "environmentally sensitive habitat" for the savanna biome. Currently, the discussion consists only of the following two sentences: "National parks and reserves have been established to preserve and protect threatened vegetative

and wildlife species in the Savanna Biome. There are several National Wildlife Refuges along the Gulf Coast."

Technical Comments and Suggested Corrections:

Appendix G Applicable Legal Requirements

Page G-10:

- Under the heading United States, in the first line and after the phrase "The Endangered Species Act of 1973" add, "as amended."
- After the phrase "requires all Federal," delete "departments and" so the line reads "requires all Federal agencies to seek."
- In the second line, delete the word "species" after "endangered."
- In the third line, after the phrase "The Secretary of the Interior was directed," insert "by the Endangered Species Act."
- In the fourth line, after the phrase "Endangered species" replace "designation" with "listing."
- In the second paragraph, last line, delete "an adequate" and insert "integrated"; delete the phrase "in place at the sites" and replace it with "determined to be of benefit to the species", so the line reads … "from critical habitat designations if an integrated natural resource management plan is determined to be of benefit to the species."

Appendix H Biome Descriptions

Page H-7:

- The scientific name of the northern sea otter is *Enhydra lutris*, not *Eumetopias jubatus*.

Page H-39:

- In a discussion of the deciduous forest biome in the northeastern States, red spruce and balsam fir forest types are listed. We note that spruce and fir are evergreen conifers, and forests dominated by them are not generally considered components of a deciduous forest biome. We also note that the preceding description of the taiga biome on pages H-16 through H-29 does not refer to balsam fir, its most prevalent tree species.
- Tropical and subtropical moist broadleaf forests are described as components of the biome; as the text notes, these forests are "dominated by semi-evergreen and evergreen tree species" and thus may be out of place in discussion of a deciduous forest biome.

- A list of examples of "threatened and endangered vegetation [sic]" in this biome includes three species from the eastern and southern U.S. and a species of moss endemic to evergreen (not deciduous) forest on the island of Madeira, which may not be the best grouping of examples to illustrate listed species in the "inland deciduous forest biome."

Page H-40:

- The discussion of wildlife of the deciduous forest biome indicates that the Florida panther "…inhabit[s] the lower coastal plains and flatlands of the middle portion of this biome." The Florida panther is found only in peninsular Florida, which would not be considered the middle portion of this biome. We suggest making this clear or deleting reference to the Florida panther is this statement.

Page H-41:

- A list of threatened and endangered wildlife includes the American black bear as if it were listed range wide; however, it is the Louisiana subspecies (*Ursus americanus luteolus*) that is actually listed as Federally threatened. *Ursus americanus* is listed as threatened due to "similarity of appearance (T (S/A))" throughout the historic range of the Louisiana black bear, which includes Louisiana, Texas, and Mississippi and is, therefore, subject to a special rule as outlined in 50 CFR 17.40(i). The black bear is not federally listed throughout the remainder of its range.
- The species *Achatinella mustelina* is attributed to hammocks in the Everglades; however, it is a snail endemic to tropical evergreen forests in Hawaii.
- The West Indian manatee is incorrectly given the scientific name of an African species (*Trichechus senegalensis*). It is correctly identified as *Trichechus manatus* in Exhibit H-6 on page H-42.

Page H-42:

- The scientific name of the leatherback sea turtle is *Dermochelys coriacea*, the DPEIS incorrectly identifies its scientific name as *Ammospiza caudacuta*.

Page H-43:

- Gorillas are incorrectly listed as inhabitants of East Asian tropical and subtropical moist forest.

Page H-90:

- *Ostrya virginiana* is given as the scientific name of the ironwood introduced on Pacific islands. However, this is a species of eastern North America; it is likely the author had in mind a species of *Casuarina*, also commonly known as ironwood.

Page H-93:

- *Esox lucius*, the northern pike, is attributed to offshore areas near the Pacific Missile Range on Kauai; however, this species is not found in the waters around the Hawaiian Islands. It is likely the author had a different species in mind.

Page H-104:

- In a discussion of the savanna biome, the harpy eagle is listed as one of its "common bird species." However, this eagle is an extremely rare bird of deep forest habitats.

We appreciate the opportunity to provide these comments. Should you have any questions, please do not hesitate to contact Vijai Rai, Team Leader, Natural Resources Management Team, Office of Environmental Policy and Compliance at (202) 208-6661.

Sincerely,

Willie R. Taylor
Director
Office of Environmental
Policy and Compliance

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

November 17, 2004

Missile Defense Agency
Ballistic Missile Defense System PEIS
c/o ICF Consulting
9300 Lee Highway
Fairfax, VA 22031

Dear Mr. Lehner:

In accordance with our responsibilities under Section 309 of the Clean Air Act and the National Environmental Policy Act (NEPA), the Environmental Protection Agency (EPA) has reviewed the Missile Defense Agency's (MDA) Ballistic Missile Defense System (BMDS) Draft Programmatic Environmental Impact Statement (DPEIS) (CEQ # 040438).

The DPEIS identifies, evaluates and documents, at the programmatic level, the potential environmental impacts of activities associated with the development, testing, deployment, and planning for the eventual decommissioning of the BMDS. It considers the current technology components, support assets, and programs that make up the proposed BMDS as well as the development and application of new technologies.

EPA commends the efforts that MDA has commenced in producing such a comprehensive and well organized document. We also appreciate your efforts in utilizing the extensive environmental analysis that is available for many of the existing components of the proposed BMDS. Based on our review of the DPEIS, we have rated the document as LO - Lack of Objections (see attached "Summary of EPA Rating System"). Although EPA has no objections to the proposed action, there are a few issues that should be clarified.

1) General Comments:

a. To assess the impacts of implementing the proposed BMDS, the DPEIS characterized the existing condition of the affected environment in the locations where various BMDS implementation activities are proposed to occur. MDA has determined that activities associated with the proposed BMDS might occur in locations around the world. Therefore, the affected environment has been considered in terms of global biomes, broad ocean areas, and the atmosphere. This has resulted in the DPEIS being very conceptual and general in nature. EPA understands that once potential BMDS locations are determined, more detailed site-specific documents will be prepared. Through the discussions on the "block approach" or the "block development process", the DPEIS has given clear indications of when follow-on NEPA analysis will occur. We agree with this approach. However, while the documents give representative examples of past, current, or proposed locations where proposed activities may occur within each biome, EPA recommends that the EIS discuss the criteria that MDA will use in making future decisions for site-specific locations.

b. The resource areas considered in this analysis are those resources that MDA believes can potentially be affected by implementing the proposed BMDS. EPA agrees that some resource areas are site-specific or local in nature and, therefore, cannot be effectively analyzed in this type of programmatic document and that the potential impacts on these resources are more appropriately discussed in subsequent site-specific documentation tiered from this PEIS. However, EPA recommends that the final document discuss the existence of multiple species habitat conservation planning efforts that are proximate to DoD lands and the potential impacts of debris on marine and aquatic ecosystems.

c. As suggested by CEQ regulations, MDA has taken advantage of the extensive environmental analyses that already exist for many of the existing components of the proposed BMDS by incorporating these materials into the DPEIS by reference. However, some of these documents are greater than 10 years old. The PEIS should confirm the validity of the information in these documents.

2) Perchlorate Comment: Because there have been differing interpretations of the science associated with the impact on human health from low level exposure to perchlorate and in the interest of resolving scientific questions, EPA, the Department of Defense, the Department of Energy, and the National Aeronautics and Space Administration - members of a broader Interagency Working Group on Perchlorate led by the Office of Science and Technology Policy - have referred scientific issues and EPA's 2002 Draft Health Assessment on Perchlorate to the National Academy of Science (NAS) for review. NAS is currently conducting a study to determine the best science and model to use for determining the health impacts and standards for perchlorate. A report on this study is expected to be completed by the end of 2004. EPA recommends that the results of the report be incorporated into the FPEIS.

We appreciate the opportunity to review this DPEIS. We also look forward to reviewing the FPEIS related to this project. The staff contact for the review is Marthea Rountree and she can be reached at (202) 564-7141.

Sincerely,

for

Anne Norton Miller
Director
Office of Federal Activities

Enclosure: Summary of Rating Definitions

SUMMARY OF EPA RATING SYSTEM

Rating the Environmental Impact of the Action

- **LO (Lack of Objections)** The review has not identified any potential environmental impacts requiring substantive changes to the preferred alternative. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposed action.
- **EC (Environmental Concerns)** The review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact.
- **EO (Environmental Objections)** The review has identified significant environmental impacts that should be avoided in order to adequately protect the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). The basis for environmental objections can include situations:
    1. *Where an action might violate or be inconsistent with achievement or maintenance of a national environmental standard;*
    2. *Where the Federal agency violates its own substantive environmental requirements that relate to EPA's areas of jurisdiction or expertise;*
    3. *Where there is a violation of an EPA policy declaration;*
    4. *Where there are no applicable standards or where applicable standards will not be violated but there is potential for significant environmental degradation that could be corrected by project modification or other feasible alternatives; or*
    5. *Where proceeding with the proposed action would set a precedent for future actions that collectively could result in significant environmental impacts.*
- **EU (Environmentally Unsatisfactory)** The review has identified adverse environmental impacts that are of sufficient magnitude that EPA believes the proposed action must not proceed as proposed. The basis for an environmentally unsatisfactory determination consists of identification of environmentally objectionable impacts as defined above and one or more of the following conditions:
    1. *The potential violation of or inconsistency with a national environmental standard is substantive and/or will occur on a long-term basis;*
    2. *There are no applicable standards but the severity, duration, or geographical scope of the impacts associated with the proposed action warrant special attention; or*
    3. *The potential environmental impacts resulting from the proposed action are of national importance because of the threat to national environmental resources or to environmental policies.*

Adequacy of the Impact Statement

- **Category 1 (Adequate)** The draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.
- **Category 2 (Insufficient Information)** The draft EIS does not contain sufficient information to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the proposal. The identified additional information, data, analyses, or discussion should be included in the final EIS.
- **Category 3 (Inadequate)** The draft EIS does not adequately assess the potentially significant environmental impacts of the proposal, or the reviewer has identified new, reasonably available, alternatives, that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. The identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. This rating indicates EPA's belief that the draft EIS does not meet the purposes of NEPA and/or the Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS.

K.5.2 Responses to Federal Agency Comments

The following comments and responses in Exhibit K-6 are organized by issue topics, including BMDS, Biological Resources, etc. The comment number includes the comment document number and the sequential number of the comment. For E0001-2, "E0001" refers to the comment document number and "2" refers to the sequential comment number.

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
BMDS	F0003-1 and M0276-1	To assess the impacts of implementing the proposed BMDS, the DPEIS characterized the existing condition of the affected environment in the locations where various BMDS implementation activities are proposed to occur. MDA has determined that activities, associated with the proposed BMDS might occur in locations around the world. Therefore, the affected environment has been considered in terms of global biomes, broad ocean areas, and the atmosphere. This has resulted in the DPEIS being very conceptual and general in nature. EPA understands that once potential BMDS locations are determined, more detailed site-specific documents will be prepared. Through the discussions on the "block approach" or the "block development process", the DPEIS has given clear indications of when follow-on NEPA analysis will occur. We agree with this approach. However, while the documents give representative examples of past, current, or proposed locations where proposed activities may occur within each biome, EPA recommends that the EIS discuss the criteria that MDA will use in making future decisions for site-specific locations.	The MDA will continue to develop test scenarios that will allow for realistic testing of the proposed BMDS. In so doing, the MDA will consider the objectives of the proposed test, the BMDS assets required/available, and potential suitable locations to meet test objectives within acceptable safety, environment, schedule, and cost-effectiveness parameters. MDA uses both DoD and commercial launch facilities and ranges to facilitate and support its test program. MDA also considers targets of opportunity (i.e., piggy-backing components on the back of other tests) when planning its testing to optimize the use of other DoD or component-specific testing to play (i.e., testing target discrimination, track and potential intercept) or watch (i.e., testing data discrimination, tracking, and interpretation capabilities of various components). MDA-sponsored tests receive NEPA consideration and determination prior to conduct of testing.
Biological Resources	F0006-3	Whales, dolphins, seals, and sea lions are protected under the Marine Mammal Protection Act (MMPA).	On January 14, 2004 MDA representatives met with NOAA Fisheries Service personnel to discuss

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
		Under the MMPA, "take" of a small number of marine mammals is permitted by NOAA Fisheries under an Incidental Harassment Authorization (IHA) when the specified activity is incidental, but not intentional. "Take" is defined as harassing, hunting, capturing, or killing, or attempting to harass, hunt, capture, or kill any marine mammal. "Harassment" is defined as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal in the wild, or has the potential to disturb a marine mammal in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. Based on the information included in the draft PEIS, the proposed project may cause take of marine mammals under the jurisdiction of NOAA Fisheries. NOAA Fisheries recommends that the Missile Defense Agency consult with the appropriate NOAA Fisheries Regional Office when conducting the site-specific analyses for potential impacts to marine mammals.	programmatic consultation pertaining to the BMDS PEIS. If site-specific analyses indicate the potential for BMDS activities to result in a "take" of species protected under the Marine Mammal Protection Act, the project proponent will consult with the NOAA Fisheries Service Regional Office, as appropriate.
Biological Resources	M0275-1	Pages 3-16 to 3-17: The portion titled "Definition and Description" emphasizes consideration of Federal and State listed species, or species proposed for listing. However, NEPA requires that other species that may be impacted by the proposed activity must also be evaluated throughout the DPEIS. See also page 4-42, subportion "Launch/Flight Activities," where impacts to only species of concern are addressed. We recommend that the DPEIS address all applicable species.	The text in Section 3.1.3 has been modified to reflect that environmental impacts to all species potentially impacted by the activities are considered in the PEIS.

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
Biological Resources	M0275-2	Pages 3-17 to 3-18: In the portion titled "Impact Assessment," we recommend the following text be inserted to address requirements in the referenced laws: If the proponent of the proposed activity determines that migratory bird species may be adversely impacted, then the proponent should confer with the Department's Fish and Wildlife Service's (FWS) Regional Migratory Bird Program to ensure compliance with the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act, where applicable. Under the MBTA, the taking of migratory birds is not authorized without a permit. The project proponent should also confer with the Service to determine if conservation measures may be implemented to minimize or avoid take of migratory birds.	Language similar to the recommended text has been added to the PEIS.
Biological Resources	M0275-3	Page 3-19: In the subportion "Determination of Significance," we recommend that reference to the MBTA be incorporated. We also recommend that the final PEIS indicate that military readiness activities implemented in the future by the MDA should be in compliance with the rule currently being finalized by the Service, "Migratory Bird Permits; Take of Migratory Birds by DoD."	Language on the Migratory Bird Treaty Act has been added to the Determination of Significance for Biological Resources. It should be noted that throughout the PEIS references are made to the fact that the project proponent would be required to comply with all applicable regulations. Therefore, specific mention of the "Migratory Bird Permits; Take of Migratory Birds by DoD" currently being finalized has not been added to the PEIS.
Biological Resources	M0275-5	Page 4-26: In the portion titled "Biological Resources," under the subportion "Land and Sea Operating Environments," we recommend adding text that indicates that hydrochloric acid could have an effect on shorebirds and waterbirds (in addition to waterfowl, which are already referenced).	A reference to shorebirds and waterbirds has been added to the discussion on the impacts to birds from hydrochloric acid in water.

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
Biological Resources	M0275-6	Page 4-27: In the last paragraph under the subportion referenced above, we recommend that the text specify the maximum noise level, if available, for which animals "generally return to normal activities within a short time following noise disturbance." Most wildlife has a limited tolerance to noise. We recommend specifying the threshold at which this tolerance level would generally be exceeded and when adverse effects may occur. See also page 4-43 where impacts to birds from noise disturbance are discussed in greater detail. These two sections should be in agreement with each other. The statement on page 4-27 is not in concurrence with the discussions on page 4-43, which indicate there may be more than minor disturbances.	The text has been modified to include details of two studies cited in the 1988 Manci et al report titled "Effects of aircraft noise on domestic animals and wildlife: a literature synthesis." (Manci, K.M., D.N. Gladwin, R. Villella, and M.G. Cadendish. 1988. Effects of aircraft noise on domestic animals and wildlife: a literature synthesis. USFWS. National Ecology Research Center, Ft. Collins, CO. NERC-88/29) Specifically, a 1982 study by Stewart (Stewart, B.S. 1982. Studies on the Pinnipeds of the Southern California Channel Islands, 1980-1981. Hubbs-Sea World Research Institute, San Diego, CA Tech Report No 82-136 as cited in Manci et al, 1988) and a 1980 study by Jehl and Cooper. (Jehl, J.R. and C.F. Cooper, eds. 1980. Potential effects of Space Shuttle booms on the biota and geology of the California Channel Islands. Research Reports Center for Marine Studies, San Diego State University, San Diego, CA. Tech Report 80-1 as cited in Manci et al, 1988)
Biological Resources	M0275-7	Page 4-64 to 4-65: We believe the analysis of impacts on birds from radar in the "Biological Resources" portion is outdated and inadequate. The first paragraph of this portion does not address the potential effects of radar on very large flocks of migrating birds. Even if a bird is not "within the most intense area of the beam for any considerable length of time," there is insufficient evidence to support the statement that no significant adverse impacts to birds would occur. The 1993 report that is referenced to support this conclusion is outdated.	In response to the Department of Interior comments regarding impacts to biological resources from radar, the MDA conducted an analysis of the potential for impact from proposed BMDS radars on migratory birds. This analysis is included in Appendix N of this PEIS. Appendix N responds to Department of Interior concerns regarding the conclusions reached in the 1993 EA and introduces possible mitigation measures.

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
		We recommend the analysis describe what constitutes a "relatively small" beam size. A beam going through a dense flock could have an adverse effect on birds, particularly for those species which are already significantly in decline. We recommend that this potential adverse effect be described. We recommend that this section discuss the potential of using NEXRAD (Next Generation Weather Radar) to help evaluate when large flocks may be in the testing area. NEXRAD could provide valuable information regarding times when testing should not occur to reduce biological impacts. This technology is currently being used by the Air Force to reduce the potential for air strikes and by the Department of Defense to identify important stopover habitat in relation to Department of Defense installations. We recommend that an avian physiologist, particularly one very knowledgeable of electromagnetic radiation, carefully review the effects of this proposed activity. In reference to the Cobra Dane study, it should be noted in the DPEIS that arctic foxes, which are very efficient predators, are present on Shemya and other Aleutian Islands, and would quickly remove evidence of any bird kills. Lack of evidence of bird die-offs under these conditions does not provide solid evidence that they aren't occurring.	

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
Biological Resources	M0275-8	Bird collisions with radar equipment, particularly towers, can have significant impacts on birds. Estimated annual bird kills from collisions with communication towers (radio, television, cellular, and microwave) range from four- to five-million, both from direct collisions with the towers themselves and with guy wires. Tall radar towers, i.e., those above 199 feet MSL (mean sea level), are of particular concern. The greatest impact occurring from towers illuminated at night with solid or pulsating incandescent red lights. In addition, the potential for tower collisions significantly increases at night under cloudy or otherwise low visibility conditions. Because of these impacts, the MDA should follow the FWS's "Interim Guidelines For Recommendations On Communications Tower Siting, Construction, Operation, and Decommissioning - 2000," for both existing and proposed radar towers. These guidelines should be referenced in the DPEIS as applying to radar equipment. They also should be applied to Re-Radiation Towers discussed in the second paragraph on page 4-77.	MDA would follow or intend to follow all relevant and applicable USFWS Guidelines whether interim or not and indicate that all applicable environmental, health and safety rules and regulations are scrupulously adhered to during MDA siting, construction, operation and decommissioning.
Biological Resources	M0275-9	Page 4-73: Under the portion titled "Biological Resources," we have similar concerns for potential impacts on migratory birds from laser sensors as those stated above for radar equipment. This is particularly true for the use of land and sea-based lasers and in situations where large flocks may be present. Although the lasers may not directly hit birds or other wildlife on the ground, impacts to birds in the air	The potential for impacts or eye injuries to biological resources including migratory birds from laser sensor activation has been characterized and described in a level of detail commensurate with the potential for impact to these resources.

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
		could be significant. We recommend that these potential impacts be described.	
Biological Resources	M0275-10	Regarding the Nominal Ocular Hazard Distance, the DPEIS concludes that impacts to wildlife from a space-based laser sensor would be insignificant because it is unlikely that the laser would be directed towards the Earth's surface and, if it were, distortion from atmospheric conditions would reduce the radiance level. It further concludes that the Earth's surface would likely be beyond the Nominal Ocular Hazard Distance. This conclusion is not well supported. We recommend that the DPEIS identify how "likely" it is that the Earth's surface would not be beyond this specified distance.	ANSI Z136.1 Safe Use of Lasers provides tables to determine the Maximum Permissible Exposure Limit (MPE) based on the wavelength, duration of exposure, and correction factors. Laser range equations are used to calculate the Nominal Ocular Hazard Distance (NOHD) based on the laser sensor MPE, classification, categorization, and other applicable laser operating characteristics. If the calculated distance of NOHD is below the Earth's surface for a space-based laser sensor to reach, the impact of that space-based laser sensor would be insignificant on the Earth surface. If specific space-based laser sensors were proposed to be used as part of the BMDS, the MDA would perform the necessary calculations to determine the NOHD. However, in general it is expected that the NOHD for space-based laser sensors would not intersect the Earth's surface.
Biological Resources	M0275-11	▪ Page 4-89 to 4-90: In reference to the first paragraph under "Biological Resources," we note that the construction of infrastructure, depending upon its extent, can significantly increase surface runoff. This can negatively impact surrounding habitats, particularly wetlands and other sensitive habitats. Impacts to fish, wildlife, and plants from pollutants could be more than temporary depending upon the pollutant and length of exposure. Depending upon the species in the project area, construction could have a larger area of disturbance than 50-feet, particularly for	▪ Language on the potential for surface runoff has been added to the PEIS. It should be noted that impacts to particular species from specific pollutants or construction projects would need to be considered in site-specific documentation.

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
		nesting bird species. We recommend that this section describe these possible impacts. ▪ We recommend that the second paragraph indicate that site preparation and installation could negatively impact waterbirds utilizing the shore environment, particularly during breeding season. ▪ In the third paragraph, we recommend that the description of behavioral responses to construction include nest abandonment and alteration of migration routes of larger mammals.	▪ A reference to waterbirds has been added to the discussion on the impacts to species from site preparation and installation of underground cable. ▪ Language similar to the recommended text regarding possible behavioral responses including nest abandonment and alteration of migration routes has been added to the PEIS.
Biological Resources	M0275-12	We recommend that the fifth paragraph list compliance with the Marine Mammal Protection Act, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act as required, where applicable. These regulatory references should also be inserted in the portion titled "Biological Resources" under Section 4.1.1.10 Support Assets - Test Assets.	Language similar to the recommended text regarding inclusion of the Marine Mammal Protection Act, Migratory Bird Treaty, and Bald and Golden Eagle Protection Act has been added to the PEIS.
Biological Resources	M0275-13	Page 4-105: Under "Integrated Ground Tests," we believe that the conclusion of insignificant impacts is not sufficiently justified or supported. This section lacks information regarding the size and orientation of the operating radar sensors. It also does not describe the anticipated increased number of these operating radar sensors.	The PEIS is a programmatic environmental analysis. The PEIS does not consider the operation of specific sensors or specific activation orientations for these sensors. In response to comments MDA added technical Appendix N, Impacts of Radar on Wildlife to the PEIS. Based on the information analyzed as part of the sensor component discussion, the analyses incorporated by reference, and the technical analyses in Appendix N in this PEIS, there is no indication that operating multiple sensors in a single biome would produce significant impacts on biological resources. The MDA believes that

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
			based on the information presented in this PEIS and on the information and analyses incorporated by reference, the expectation of insignificant impacts to biological resources from integrated ground tests is supported in the PEIS. However, it should be noted that test-specific analyses would be prepared to determine whether the potential for significant impacts exists for a specific test scenario.
Biological Resources	M0275-14	Page 4-133: As stated above, we believe that statements of no significant impact are not sufficiently justified or supported. This section indicates Best Management Practices would be implemented to mitigate adverse effects. However, the DPEIS does not provide sufficient information regarding what these measures might be or what would be recommended. In addition, the conclusion that "those [effects] that could not be avoided should not result in a significant impact to the environment" could be viewed as arbitrary since those effects are insufficiently described.	Section 4.4 of the PEIS states that "Adverse environmental effects that cannot be avoided include the removal of vegetation during site preparation and construction activities; minor short-term noise impacts startling of wildlife; deposition of small amounts of pollutants on land, air, and sea; minor increased generation of hazardous materials; and emission of EMR." This Section of the PEIS further states that these effects are not expected to result in significant impact to the environment. These effects were described in Sections 4.1.1.1 through 4.3 and on a programmatic level were found to have no significant impact to the environment. The PEIS is intended to serve as a tiering document for future site-specific analyses. These site-specific analyses would determine whether site or test specific characteristics would lead to a potentially significant impact. These impacts will be appropriately considered in these tiered analyses. The tiered analyses may also consider specific mitigation measures including Best Management Practices that are appropriate for the action or test under consideration.

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
Biological Resources	M0275-27	A list of threatened and endangered wildlife includes the American black bear as if it were listed range wide; however, it is the Louisiana subspecies {Ursus americanus luteolus) that is actually listed as Federally threatened. Ursus americanus is listed as threatened due to "similarity of appearance (T (S/A))" throughout the historic range of the Louisiana black bear, which includes Louisiana, Texas, and Mississippi and is, therefore, subject to a special rule as outlined in 50 CFR 17.40(i). The black bear is not federally listed throughout the remainder of its range.	The reference to the American black bear has been removed. It should be noted that the species listed in Appendix H are examples of species that are listed as threatened or endangered in the Deciduous forest biome.
Biological Resources	M0275-28	The species Achatinella mustelina is attributed to hammocks in the Everglades; however, it is a snail endemic to tropical evergreen forests in Hawaii.	The reference to Achatinella mustelina has been removed.
Biological Resources	M0275-29	The West Indian manatee is incorrectly given the scientific name of an African species {Trichechus senegalensis). It is correctly identified as Trichechus manatus in Exhibit H-6 on page H-42.	The reference to the West Indian manatee's scientific name has been corrected.
Biological Resources	M0275-30	The scientific name of the leatherback sea turtle is Dermochelys coriacea, the DPEIS incorrectly identifies its scientific name as Ammospiza caudacuta.	The reference to the leatherback sea turtle's scientific name has been corrected.
Biological Resources	M0275-31	Gorillas are incorrectly listed as inhabitants of East Asian tropical and subtropical moist forest.	The reference to gorillas living in the East Asian tropical and subtropical moist broadleaf forests has been removed.
Biological Resources	M0275-32	Ostrya virginiana is given as the scientific name of the ironwood introduced on Pacific islands. However, this is a species of eastern North America; it is likely the author had in mind a species of Casuarina, also commonly known as ironwood.	The reference to Ostrya virginiana as being the scientific name of ironwood species introduced on Pacific islands has been removed.
Biological Resources	M0275-33	Esox lucius, the northern pike, is attributed to offshore areas near the Pacific Missile Range on Kauai;	The reference to Esox lucius has been removed.

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
		however, this species is not found in the waters around the Hawaiian Islands. It is likely the author had a different species in mind.	
Biological Resources	M0275-34	In a discussion of the savanna biome, the harpy eagle is listed as one of its "common bird species." However, this eagle is an extremely rare bird of deep forest habitats.	The reference to the harpy eagle being a "common bird species" of the savanna biome has been removed.
Biological Resources – Debris Impacts	F0003-2 and M0276-2	The resource areas considered in this analysis are those resources that MDA believes can potentially be affected by implementing the proposed BMDS. EPA agrees that some resource areas are site-specific or local in nature and, therefore, cannot be effectively analyzed in this type of programmatic document and that the potential impacts on these resources are more appropriately discussed in subsequent site-specific documentation tiered from this PEIS. However, EPA recommends that the final document discuss the existence of multiple species habitat conservation planning efforts that are proximate to DoD lands and the potential impacts of debris on marine and aquatic ecosystems.	The potential impacts of debris in marine and aquatic ecosystems were considered as part of Postlaunch Activities for each resource area analyzed in the PEIS. These discussions highlighted the potential programmatic environmental impacts from launch debris impacting in water environments. Although it would not be appropriate to discuss specific multiple species habitat conservation areas that are proximate to DoD lands in this programmatic document, a statement about multiple species habitat conservation planning efforts has been added to Section 3.2.3 of the PEIS.
Hazardous Materials Hazardous Waste	F0006-1	NOAA Fisheries recommends that the Missile Defense Agency be responsible for handling and disposing of all hazardous materials or hazardous wastes in all phases of the proposed action in accordance with applicable Federal, state, and local laws, utilizing best management practices at all life cycle activities of the proposed action and through appropriate project planning and design measures including appropriate spill prevention, control and	The disposal of all hazardous materials and hazardous wastes would be conducted in compliance with applicable Federal, state, and local laws. Project planning would take spill prevention, control, and contingency planning into account to ensure compliance with all relevant regulations.

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
		contingency plans (e.g., Oil Discharge Prevention and Contingency Plan, Storm Water Pollution Prevention Plan) for each site.	
Perchlorate	F0003-4 and M0276-4	Perchlorate Comment: Because there have been differing interpretations of the science associated with the impact on human health from low level exposure to perchlorate and in the interest of resolving scientific questions, EPA, the Department of Defense, the Department of Energy, and the National Aeronautics and Space Administration - members of a broader Interagency Working Group on Perchlorate led by the Office of Science and Technology Policy -have referred scientific issues and EPA's 2002 Draft Health Assessment on Perchlorate to the National Academy of Science (NAS) for review. NAS is currently conducting a study to determine the best science and model to use for determining the health impacts and standards for perchlorate. A report on this study is expected to be completed by the end of 2004. EPA recommends that the results of the report be incorporated into the FPEIS.	In addition to citing the Perchlorate Study Group findings, the Final PEIS has been modified to include the proposed findings from the State of California Office of Environmental Health Hazard Assessment, the State of Massachusetts, and U.S. EPA. The results of relevant reports and findings completed prior to the finalization and publication of the PEIS were included as appropriate. The proposed BMDS activities would need to comply with all applicable regulations including any regulations issued regarding perchlorate levels. To better characterize some of the potential impacts associated with proposed BMDS activities, additional information and research on perchlorate has been added to Section 4.1.1.2 of the Final PEIS. Further, a technical appendix (see Appendix M) addressing issues specifically related to perchlorate has been added to the Final PEIS. The appendix considers the uses, sources, and disposal of perchlorate as well as the effects on human health and the environment.
Editorial	M0275-16	Under the heading United States, in the first line and after the phrase "The Endangered Species Act of 1973" add, "as amended."	Editorial and other text modifications made as requested.
Editorial	M0275-17	After the phrase "requires all Federal," delete "departments and" so the line reads "requires all Federal agencies to seek."	Editorial and other text modifications made as requested.
Editorial	M0275-18	In the second line, delete the word "species" after "endangered."	Editorial and other text modifications made as requested.

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
Editorial	M0275-19	In the third line, after the phrase "The Secretary of the Interior was directed," insert "by the Endangered Species Act."	Editorial and other text modifications made as requested.
Editorial	M0275-20	In the fourth line, after the phrase "Endangered species" replace "designation" with "listing."	Editorial and other text modifications made as requested.
Editorial	M0275-21	In the second paragraph, last line, delete "an adequate" and insert "integrated"; delete the phrase "in place at the sites" and replace it with "determined to be of benefit to the species", so the line reads…"from critical habitat designations if an integrated natural resource management plan is determined to be of benefit to the species." Modification made as requested.	Editorial and other text modifications made as requested.
Editorial	M0275-22	The scientific name of the northern sea otter is Enhydra lutris, not Eumetopias jubatus.	Editorial and other text modifications made as requested.
Affected Environment	M0275-15	Page H-106: We suggest expanding the discussion of "environmentally sensitive habitat" for the savanna biome. Currently, the discussion consists only of the following two sentences: "National parks and reserves have been established to preserve and protect threatened vegetative and wildlife species in the Savanna Biome. There are several National Wildlife Refuges along the Gulf Coast."	Editorial and other text modifications made as requested.
Affected Environment	M0275-23	In a discussion of the deciduous forest biome in the northeastern States, red spruce and balsam fir forest types are listed. We note that spruce and fir are evergreen conifers, and forests dominated by them are not generally considered components of a deciduous forest biome. We also note that the preceding description of the taiga biome on pages H-16 through	Editorial and other text modifications made as requested.

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
		H-29 does not refer to balsam fir, its most prevalent tree species.	
Affected Environment	M0275-24	Tropical and subtropical moist broadleaf forests are described as components of the biome; as the text notes, these forests are "dominated by semi-evergreen and evergreen tree species" and thus may be out of place in discussion of a deciduous forest biome.	Editorial and other text modifications made as requested.
Affected Environment	M0275-25	A list of examples of "threatened and endangered vegetation [sic]" in this biome includes three species from the eastern and southern U.S. and a species of moss endemic to evergreen (not deciduous) forest on the island of Madeira, which may not be the best grouping of examples to illustrate listed species in the "inland deciduous forest biome."	Editorial and other text modifications made as requested.
Affected Environment	M0275-26	The discussion of wildlife of the deciduous forest biome indicates that the Florida panther"... inhabit[s] the lower coastal plains and flatlands of the middle portion of this biome." The Florida panther is found only in peninsular Florida, which would not be considered the middle portion of this biome. We suggest making this clear or deleting reference to the Florida panther is this statement.	Editorial and other text modifications made as requested.
NEPA Process	F0006-2	Based on the information provided in the draft PEIS, NOAA Fisheries recommends that the Missile Defense Agency consult with the appropriate NOAA Fisheries Regional Office to determine if listed species under the Endangered Species Act (ESA) of 1973 as amended (16.U.S.C. 1531 et. seq.) may be affected by the proposed project. If it is determined that this project may affect a listed or proposed species, the Missile Defense Agency should request	On January 14, 2004 MDA representatives met with NOAA Fisheries Service personnel to discuss programmatic consultation pertaining to the BMDS PEIS. If site-specific analyses indicate the potential for BMDS activities to result in a "take" of species protected under the Endangered Species Act of 1973 as amended (16.U.S.C. 1531 et. seq.), the project proponent will consult with the NOAA Fisheries Service Regional Office, as appropriate.

Exhibit K-6. Responses to Federal Agency Comments

Issue Topic	Comment Number	Excerpt Text	Response
		initiation of consultation with NOAA Fisheries pursuant to section 7 of the ESA.	
	F0003-3 and M0276-3	As suggested by CEQ regulations, MDA has taken advantage of the extensive environmental analyses that already exist for many of the existing components of the proposed BMDS by incorporating these materials into the DPEIS by reference. However, some of these documents are greater than 10 years old. The PEIS should confirm the validity of the information in these documents.	In accordance with 40 CFR § 1502.21, Incorporation by Reference, information that was incorporated by reference in the PEIS has been cited and briefly described in the PEIS and made available during the public review period. The MDA has reviewed the portions of the information from these documents that are incorporated by reference and found them to be valid and relevant to this PEIS.

APPENDIX L
ORBITAL DEBRIS TECHNICAL APPENDIX

ORBITAL DEBRIS TECHNICAL APPENDIX

L.1 Introduction

This appendix defines orbital debris, discusses its source, fate and disposal options, presents an overview of policies and regulations associated with orbital debris, and concludes with how the MDA addresses orbital debris. This appendix is organized as follows:

- Background information, including definitions and descriptions, fate and disposal options, and ground-based tracking and monitoring
- Current standards and policies, including those implemented by the DoD, NASA and the U.S. Strategic Command (USSTRATCOM)
- MDA activities that produce orbital debris and MDA's coordination with appropriate agencies (e.g., USSTRATCOM and NASA)
- References

L.2 Background Information

This section defines and describes orbital debris. The fate of orbital debris and options for its disposal are discussed, as well as measurements and other data associated with the ground-based tracking and monitoring of orbital debris.

L.2.1 Definition and Description

Orbital debris as considered in this appendix is man-made material that is in orbit around the Earth but no longer serves any useful purpose. This definition excludes the large amount of background or natural space debris (i.e., asteroids and comets) resident in space. Natural space debris occurs in densities several orders of magnitude greater than man-made space debris.

Orbital debris includes such objects as

- Discarded hardware (e.g., upper stages from launch vehicles),
- Abandoned satellites,
- Separations of spacecraft (e.g., bolts, adaptor shrouds),
- Material degradation (e.g., paint flakes, bits of insulation), and
- Object breakup (more than 124 have been identified).

NASA has defined four types of orbital debris

- Large objects that are larger than 10 centimeters (4 inches) in diameter and are routinely detected, tracked, and catalogued;
- Risk objects between one centimeter (0.4 inch) and 10 centimeters (4 inches) in diameter, which cannot be tracked and catalogued;
- Small debris that is between one centimeter (0.4 inch) and one millimeter (0.04 inch) in diameter; and
- Micro debris which is smaller than one millimeter (0.04 inch) in diameter.

The interaction among these four sizes of orbital debris during their time in orbit creates concern that there may be collisions producing additional fragments and causing the total debris population to grow, which may increase the potential for debris reentry into Earth's atmosphere. Debris in each of the four size categories can be divided further into four types depending on its source.

- ***Operational debris*** is composed of inactive payloads and objects released during satellite delivery or satellite operations, including such items as lens caps, separation and packing devices, spin-up mechanisms, empty propellant tanks, spent and intact vehicle bodies, payload shrouds, and a few objects thrown away or dropped during manned activities. (Aerospace Corporation, 2005)

- ***Fragmentation debris*** results from collisions or explosions of objects in space. More than 124 breakups have been verified, and it is estimated that a significant number of others have occurred. (Aerospace Corporation, 2005) Breakups result in the fragmentation of space objects and are generally caused by either the collision of two space objects or an explosion. Explosions cause the majority of breakups. The causes of most explosions can be attributed to

    - Deliberate collisions,
    - Accidental mixing of propellant and oxidizer, and
    - Over-pressurized batteries or propellant (due to heating).

- ***Deterioration debris*** consists of very small debris particles created by the gradual disintegration of spacecraft (e.g., satellites, booster rockets, and manned spacecraft) left on orbit. Material from the spacecraft degrades in space due to atomic oxygen, solar heating, and solar radiation, producing items such as paint flakes, plastic and metal micro debris, and bits of insulation. (Aerospace Corporation, 2005)

- ***Solid rocket motor ejecta*** are typically less than 0.01 centimeter (0.004 inch) in diameter (i.e., micro debris) and result from the ejection of thousands of kilograms of Al_2O_3 particles from SRMs into the orbital environment. (U.S. DOT, 2001) SRMs

used to boost satellite orbits have produced various debris items, including motor casings, aluminum oxide exhaust particles, nozzle slag, motor-liner residuals, solid-fuel fragments, and exhaust cone bits resulting from erosion during the burn. SRMs may release larger chunks of unburned solid propellant or slag produced when most of the solid propellant has been expended and the combustion pressure inside the rocket motor begins to fluctuate or when unspent propellant is expelled into space. However, SRM particles and ejecta typically decay very rapidly or are dispersed by solar radiation pressure. (U.S. DOT, 2001)

Orbital debris generally moves at very high speeds relative to operational satellites. In Low Earth Orbit (LEO), an altitude approximately 1,600 kilometers (1,000 miles) above the surface of the Earth, the average relative velocity at impact is 10 kilometers per second (21,600 miles per hour). At this velocity, even small particles contain significant amounts of kinetic energy and momentum. In GEO, an altitude of approximately 35,000 kilometers (22,000 miles) above the Earth's surface, average relative velocity at impact is much lower than in LEO, about 200 meters per second (432 miles per hour). This is because most objects in GEO move along similar orbits. Nevertheless, fragments at this velocity can still cause considerable damage upon impact. A 10-centimeter (4-inch) fragment in GEO has roughly the same damage potential as a 1-centimeter (0.4-inch) fragment in LEO. A 1-centimeter (0.4-inch) GEO fragment is roughly equivalent to a 1-millimeter (0.04-inch) LEO fragment.

Estimates of the amount of orbital debris vary. According to the NASA Orbital Debris Program Office, approximately 11,000 objects larger than 10 centimeters (4 inches) are known to exist, more than 100,000 particles between one and 10 centimeters (0.4 to 4 inches) in diameter exist, and tens of millions of particles smaller than one centimeter (0.4 inch) exist. (NASA, 2004b) According to the European Space Agency, in 2003 there were approximately 10,000 catalogued debris objects orbiting the Earth. General damage levels associated with the various sizes of debris can be described as follows.

- Debris particles smaller than 1 millimeter (0.04 inch) in size do not generally pose a hazard to spacecraft functionality. However, they can erode sensitive surfaces such as payload optics; thus, while the spacecraft may survive an impact, payload degradation can still result in mission loss.

- Debris fragments from 1 millimeter to 1 centimeter (0.04 to 0.4 inch) in size may or may not penetrate a spacecraft, depending on material selection and whether shielding is used. Penetration through a critical component, such as the flight computer or propellant tank, can result in loss of the spacecraft. On average, debris of one millimeter (0.04 inch) is capable of perforating current U.S. space suits.

- Debris fragments between 1 and 10 centimeters (0.4 to 4 inches) in size will penetrate and damage most spacecraft. If the spacecraft bus is impacted, satellite function will

be terminated and, at the same time a significant amount of small debris will be created. In large satellite constellations, this can lead to amplification of the local smaller debris population and its associated erosion effects.

While it is currently practical to shield or protect spacecraft against debris particles up to one centimeter (0.4 inch) in diameter (a mass of one gram [0.05 ounce]), for larger debris, current shielding concepts become impractical. (NASA, 2003)

Orbital debris also contributes to the larger problem of objects in space, which includes radio-frequency interference and interference with scientific observations in all parts of the spectrum. For example, emissions of debris at radio frequencies often interfere with radio astronomy observations. (NASA, 2003)

Measurements of near-Earth orbital debris are accomplished by conducting ground-based and space-based observations of the orbital debris environment. Data are acquired using ground-based radars and optical telescopes, space-based telescopes, and analysis of spacecraft surfaces returned from space. Some important data sources have been the U.S. Space Surveillance Network (SSN), the Haystack XBR, and returned surfaces from the Solar Max, Long Duration Exposure Facility, and the Space Shuttle spacecraft. The data provide validation of the environment models and identify the presence of new sources of debris. (NASA, 2005)

L.2.2 Fate and Disposal Options

Once orbital debris is formed, it continues to exist in space. Two types of orbits where satellites are stationed and where orbital debris is generated include LEO (see Exhibit L-1) and GEO (see Exhibit L-2). Debris generated at those altitudes would continue orbiting the Earth for extended periods of time (perhaps forever) before the orbit of the debris decays, drawing it closer and closer to Earth. The duration of orbit varies based on the trajectory, velocity, and altitude of an object, with lower altitude orbits decaying faster than high altitude orbits. This is because orbiting objects lose energy through friction with the upper reaches of the atmosphere, which is progressively thinner (less dense) at higher altitudes. Over time, the object falls into progressively lower orbits and eventually falls toward the Earth.

Exhibit L-1. Orbital Debris in LEO

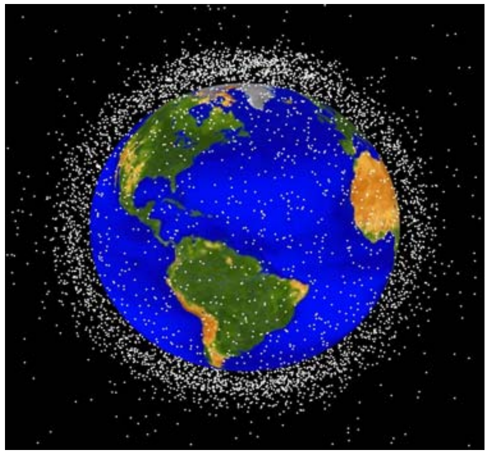
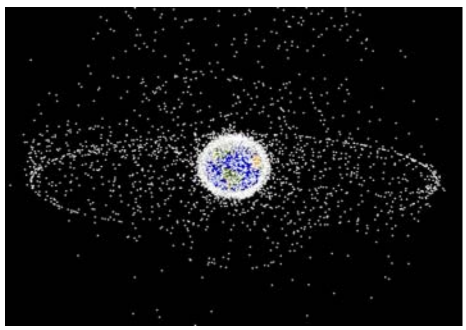


Exhibit L-2. Orbital Debris in GEO



As debris eventually reenters the Earth's atmosphere, it would most likely burn up before reaching the surface of the Earth. This deorbit process limits the lifetime of orbital debris to a maximum of a few days for debris below 200 kilometers (124 miles), a few months for debris originating between 200 kilometers (124 miles) and 400 kilometers (248 miles), a few years between 400 kilometers (248 miles) and 600 kilometers (373 miles), decades between 600 kilometers (373 miles) and 800 kilometers (497 miles), centuries over 800 kilometers (497 miles), and potentially forever if over 36,000 kilometers (22,370 miles). (NASA, 2004a)

The proper disposal of post-mission space structures is critically important to minimizing the amount and future impact of space debris orbiting the Earth. Post-mission space structures are those objects that have been left in space after a mission is complete, and is not planned to be returned to earth (e.g., satellites). Historically, about 2 million kilograms (4.4 million pounds) of space debris has accumulated in orbit because of the practice of abandoning, rather than disposing of, spacecraft at the end of their mission life. (NASA, 1995) This debris poses a threat to continued space operations and increases the likelihood of collisions between two objects in space.

In general, there are three post-mission disposal options available to minimize the creation of orbital debris: (1) direct retrieval and deorbit; (2) reentry disposal; and (3) moving the object to a designated post-mission disposal orbit. (NASA, 1995) Direct retrieval and deorbit refers to retrieving the structure and removing it from orbit at some point after mission completion. Reentry disposal refers to allowing the object to slowly break up as it reenters the Earth's atmosphere. (Patera and Ailor, 1998) "Moving the object…" refers to maneuvering the object to one of a set of disposal orbit regions in which the object will not interfere with future space operations. A disposal orbit region is also known as a graveyard orbit, which is generally a higher altitude orbit where a satellite or other object is placed at the end of its operational life. In a graveyard orbit, a space object is not expected to accidentally collide with an active satellite. However, it is assumed that one day it will eventually reenter Earth's atmosphere and burn up. (Encyclopedia, 2005)

Generally, reentry disposal is not viewed as hazardous to people on Earth because the intense heat generated by atmospheric drag upon reentry is expected to completely destroy the debris. Furthermore, the probability of a surviving piece of the debris striking an inhabited part of the Earth is very low. However, as both the human population on Earth and the number of satellites in the sky increases, the probability of a piece of a reentered satellite randomly striking a population center also increases.

There are two means of disposing of a satellite (or other structure) through reentry breakup: lifetime reduction, which results in a random reentry; and disposal by controlled deorbit, which seeks to target an unpopulated area of the Earth (usually the ocean). (Patera and Ailor, 1998) Lifetime reduction refers to maneuvering the object to an orbit from which atmospheric drag will remove it completely from orbit within 25 years. (NASA, 1995) This approach may result in an uncertain time and place of disposal and makes warning population centers of an impending strike impossible. Disposal by controlled deorbit seeks to guide the structure to a desired impact location through a series of perigee (the point at which the structure is closest to Earth) lowering burns. (Antonio, 2005) This approach is more appropriate than lifetime reduction under the following conditions (Patera and Ailor, 1998)

- The mass of the structure is especially large,
- The structure contains hazardous materials that may pose a safety threat to populations, or
- The structure contains sensitive components that need to be destroyed.

There are a number of options available for disposing an object via moving it to a designated orbital disposal region. These regions are areas of space that are between the three typical areas in which satellites orbit the Earth: LEO, Medium Earth Orbit (semisynchronous) (MEO), and GEO. LEO is the area between the Earth and approximately 1,600 kilometers (1,000 miles) above the Earth; MEO is the area between

around 19,900 and 20,500 kilometers (12,366 and 12,738 miles) above the Earth; and GEO is the area between aproximately 35,0000 and 36,000 kilometers (22,000 and 22,400 miles) above the Earth. (NASA, 1995)

Spacecraft that reenter from either orbital decay or controlled entry usually break up at altitudes between 84 and 72 kilometers (52 and 45 miles) due to aerodynamic forces causing the allowable structural loads to be exceeded. The nominal breakup altitude for spacecraft is considered to be 78 kilometers (48.5 miles). Larger, sturdier, and denser satellites generally break up at lower altitudes. Solar arrays frequently break off the spacecraft parent body around 90 to 95 kilometers (56 to 59 miles) because of the aerodynamic forces causing the allowable bending moment to be exceeded at the array/spacecraft attach point.

Recognizing the growing issue of space debris, both NASA and USSTRATCOM have developed policies to regulate future post-mission disposal of satellites and other space structures. NASA's guidelines provide disposal methods for final mission orbits according to altitude, while USSTRATCOM's policy directive covers the appropriate methods for satellite disposal. Sections 3.1 and 3.2 provide outlines of the policies of both NASA and USSTRATCOM regarding spacecraft or space structure disposal.

L.2.3 Ground-Based Tracking and Monitoring

Ground-based measurements are used to remotely sense the presence of space debris. This is normally done using radar measurements for debris in LEO or optical measurements for debris in GEO. The following characteristics of the debris can be derived from radar measurements (with varying degrees of uncertainty)

- Orbital elements, which describe the motion of the object's center of mass around Earth,
- Attitude, which describes the motion of the object around its center of mass,
- Size and shape,
- Lifetime of the orbit,
- Ballistic coefficient, which specifies the rate at which the orbital semi-major axis decays,
- Mass of the object, and
- Properties of the material.

These data, along with statistical information on the number of objects of a certain size in a certain region over a period of time, are entered into catalogues of space objects. Several catalogues currently track space objects, including the USSTRATCOM catalogue and the space object catalogue of the Russian Federation. Using both of these catalogues, the Database and Information System Characterizing Objects in Space (DISCOS) is updated and maintained by the European Space Agency. Information contained in

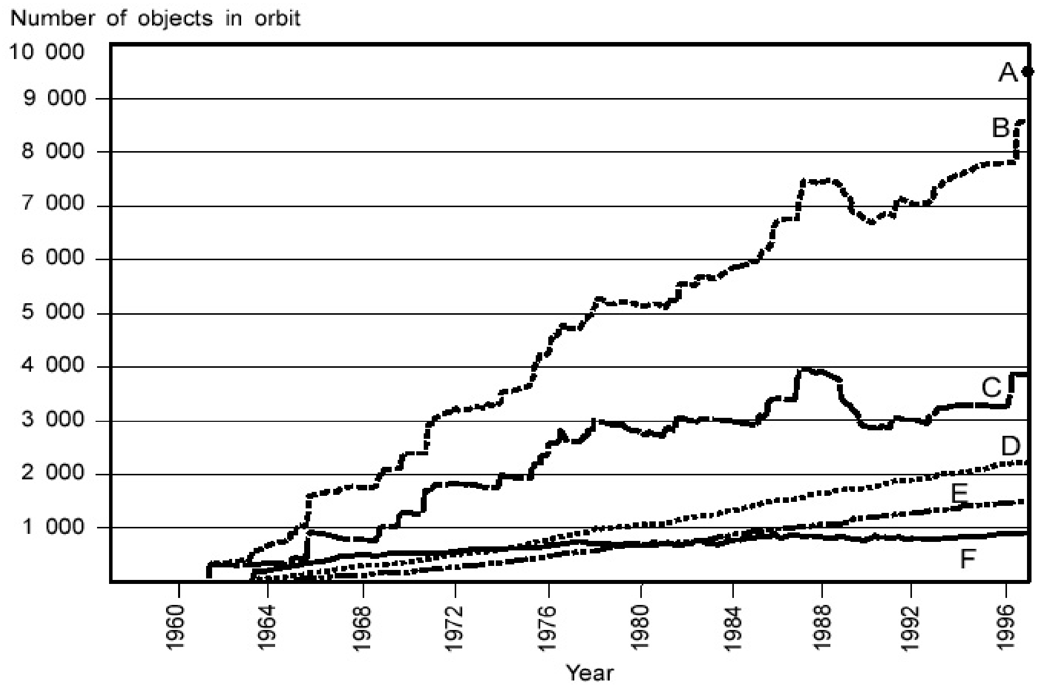
DISCOS includes the location and number of current orbital objects; a historical record of debris in orbit; data that can be used to model the behavior of orbiting objects; and data through which future launch and operational activity can be predicted. (United Nations, 2005)

According to the European Space Agency, in 2003 there were approximately 10,000 catalogued debris objects orbiting the Earth, while there is no good estimate for exactly how many uncatalogued objects exist. The 10,000 catalogued objects were categorized into the following five types with the distribution of each as noted

- Operational spacecraft – 7 percent,
- Mission-related objects – 13 percent,
- Rocket bodies – 17 percent,
- Old spacecraft – 22 percent,
- Miscellaneous fragments – 41 percent.

Exhibit L-3 shows the total number of objects in orbit by year and type of object.

Exhibit L-3. Number of Objects in Orbit by Year and Type of Object



A: Total number of objects, including objects not contained in the official catalogue
B: Total number of objects, based on the official catalogue
C: Fragmentation debris; fragments are counted since the year of event; fragmentation parents are counted as intacts until the date of event; since the event date the parents are counted as fragments
D: Spacecraft
E: Rocket bodies
F: Operational debris; operational debris related to a launch are counted since the year of launch; Salyut 4, 5, 6, 7 and Mir operational debris are not counted since the date of launch of the parent but since a more realistic date

Note: This figure does not take into account objects that have re-entered the atmosphere.

Source: United Nations, 2005

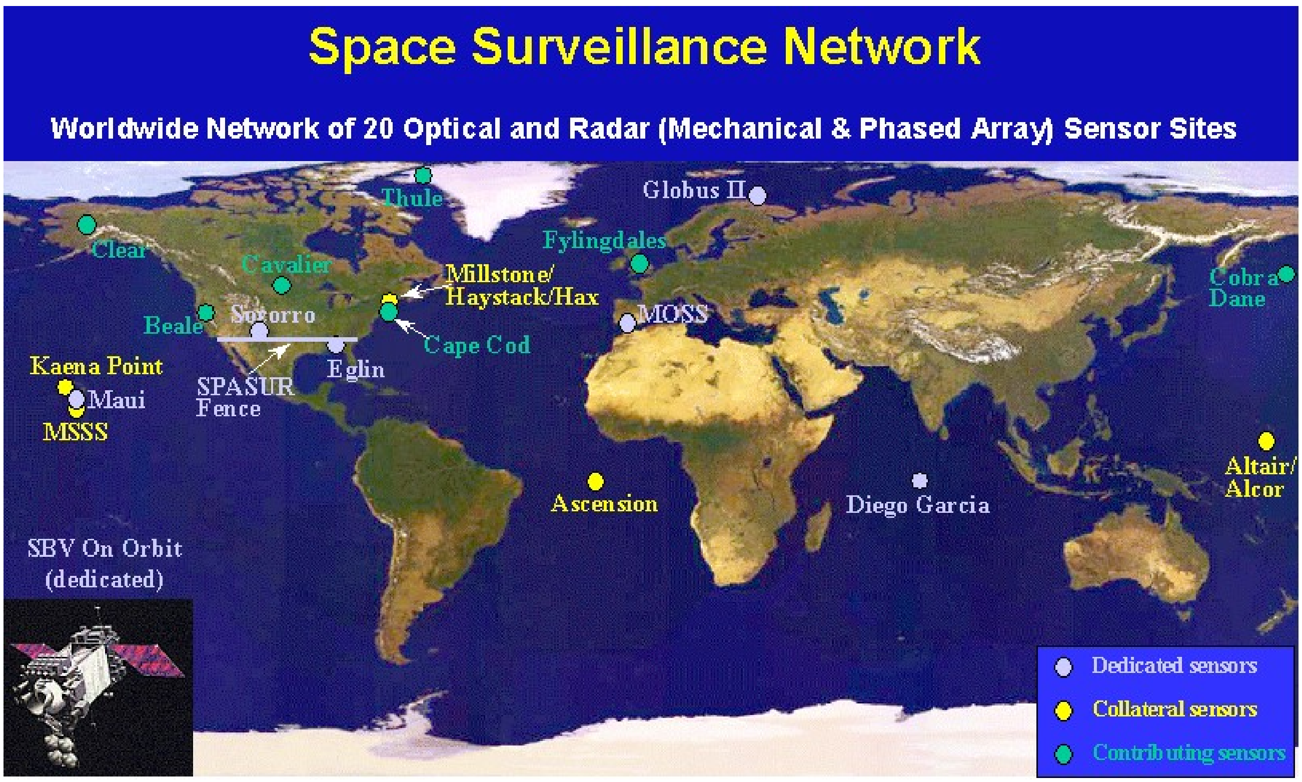
USSTRATCOM uses its SSN to accomplish space surveillance tasks. This involves detecting, tracking, identifying, and cataloging man-made objects orbiting the Earth, including active and inactive satellites, spent rocket bodies, or fragmentation debris. The functions of USSTRATCOM include

- Predicting when and where a decaying space object will re-enter the Earth's atmosphere,
- Charting the present position of space objects and predicting their paths,
- Detecting new man-made objects in space,

- Producing a catalogue of man-made objects in space,
- Determining which country owns a reentering object, and
- Informing NASA if any object might interfere with the space shuttle or the ISS.

The SSN is comprised of ground-based radars and optical sensors at 25 sites operated by the U.S. Army, Navy, or Air Force. Exhibit L-4 depicts the locations of 20 of these sensor sites. Since its beginning in 1957, SSN has tracked 24,500 space objects and currently tracks 8,000 orbiting objects. While its primary concern is operational satellites, USSTRATCOM tracks all space objects greater than 10 centimeters (4 inches) in diameter, including space debris. (U.S. Space Command, 2005)

Exhibit L-4. USSTRATCOM Space Surveillance Network



Source: U.S. Space Command, 2005

USSTRATCOM estimates that of the space objects it tracks, 7 percent are operational satellites, 15 percent are rocket bodies, and 78 percent are inactive or fragmented satellites. (U.S. Space Command, 2005) Therefore, commercial and government satellites are by far the largest contribution to not only space objects but to space debris as well.

L.3 Standards and Policy for Managing Orbital Debris

This section discusses various Federal standards and guidelines for managing and minimizing the risk from orbital debris. This includes the National Space Policy, White House Office of Science and Technology Policy (OSTP), 2006; DoD Directive 3100.10; NASA Safety Standard 1740.14; and the AFSPC policy directive *UPD10-39*.

L.3.1 National Space Policy (OSTP, 2006)

The National Space Policy was issued by the White House Office of Science and Technology Policy in 2006 and addresses specific space guidelines for civil space, commercial space, and national security. In order to support major U.S. space policy objectives, the policy identifies priority intersector guidance related to the defense, international, civil, and commercial space sectors. Among this intersector guidance, issues concerning space debris minimization are addressed. The policy states that NASA, the intelligence community, and DoD, in cooperation with the private sector, will develop design guidelines for future Government procurements of spacecraft, launch vehicles, and services. The design and operation of space tests, experiments, and systems will minimize or reduce accumulation of space debris consistent with mission requirements and cost-effectiveness.

Because it is in the interest of the U.S. Government to ensure that space debris minimization practices are applied by other space faring nations and international organizations, the policy states that the U.S. Government will take a leadership role in international forums to adopt policies and practices aimed at debris minimization. In addition, the U.S. Government will cooperate internationally in the exchange of information on debris research and the identification of debris mitigation options.

L.3.2 Department of Defense Directive 3100.10

The DoD Directive 3100.10 issued in July of 1999 is an update of the DoD Space Policy. It incorporates new policies and guidance disseminated since the last DoD Space Policy update in 1987. It assigns responsibilities and establishes a comprehensive policy framework for the conduct of space and space-related activities. This framework is meant to help articulate the need for capabilities, guide the allocation of resources, and direct program activities.

Among the operational guidance provided, the directive echoes the White House's 1996 National Space Policy regarding the minimization of space debris created. It states that the design and operation of space tests, experiments, and systems shall strive to minimize or reduce the accumulation of such debris consistent with mission requirements and cost effectiveness.

The directive also addresses policy regarding spacecraft end-of-life. It states that spacecraft disposal at the end of mission life shall be planned for programs involving on-orbit operations. Spacecraft disposal shall be accomplished by atmospheric reentry, direct retrieval, or maneuver to a storage orbit to minimize or reduce the impact on future space operations.

L.3.3 NASA Standard

NASA's Safety Standard 1740.14, *Safety Standard Guidelines and Assessment Procedures for Limiting Orbital Debris*, is a set of guidelines addressing how to dispose of spacecraft and structures that will eventually become orbital debris. The standard is divided into three different categories according to the altitude of the spacecraft or structure. These categories apply to structures at altitudes below 2,000 kilometers (1,243 miles), above 2,000 kilometers (1,243 miles), and those that are in near-circular 12-hour orbits. (NASA, 1995)

Spacecraft or structures with perigee altitude (the point at which the structure is closest to the Earth) below 2,000 kilometers (1,243 miles) in its final mission orbit will be disposed of by one of three methods. These are considered the methods of disposal for final mission orbits passing through LEO.

- ***Atmospheric reentry option*** - The structure is left in an orbit. Using conservative projections for solar activity, the structure will last no longer than 25 years after completion of mission. This is due to atmospheric drag. If drag enhancement devices are used to reduce the orbit lifetime, it must be demonstrated that such devices will significantly reduce the area-time product of the system or will not cause spacecraft or large debris to fragment if a collision occurs while the system is decaying from orbit.

- ***Maneuvering to a storage orbit between LEO and GEO*** - The structure can maneuver to an orbit with a perigee altitude above 2,500 kilometers (1,554 miles) and an apogee (the point at which the structure is furthest from Earth) altitude below 35,288 kilometers (21, 928 miles) (500 kilometers [311 miles] below GEO altitude). (Antonio, 2005)

- ***Direct retrieval*** - The structure is retrieved and removed from orbit within 10 years after completion of the mission.

Spacecraft or structures with perigee altitude above 2,000 kilometers (1,243 miles) in their final mission orbits will be disposed of by one of two methods. These are considered the methods of disposal for final mission orbits with perigee altitudes above LEO.

- ***Maneuvering to a storage orbit above GEO altitude*** - Maneuver to an orbit with a perigee altitude above the GEO altitude by a specific distance, which must be calculated according to a formula. A program will use the post-mission disposal strategy that has the least risk of leaving the vehicle near GEO in the event of a failure during the disposal process. Because of fuel gauging uncertainties near the end of mission, it is suggested that the maneuver be performed in a series of at least four burns, which alternately raise apogee and then perigee.

- ***Maneuvering to a storage orbit between LEO and GEO*** - Maneuver to an orbit with perigee altitude above 2,500 kilometers (1,554 miles) and apogee altitude below 35,288 kilometers (21,928 miles) (500 kilometers [311 miles] below GEO altitude).

Final mission orbits with perigee altitudes above 19,900 kilometers (12,366 miles) and apogee altitudes below 20,500 kilometers (12,739 miles), as well as final mission orbits that are (300 kilometers [186 miles] near-circular 12-hour orbits are disposed of using another method. For such orbits, the spacecraft or structure should be maneuvered to an orbit with perigee altitude above 2,500 kilometers (1,554 miles) and apogee altitude below 19,900 kilometers 12,366 miles) or to an orbit with perigee altitude above 20,500 kilometers (12,739 miles) and apogee altitude below 35,288 kilometers (21,928 miles). This would result in placing the spacecraft or structure approximately 500 kilometers [311 miles] below or above GEO altitude.

L.3.4 USSTRATCOM Policy Directive

USSTRATCOM is a unified command under the DoD that oversees the Army, Navy and Air Force Space Commands. In 2001, the U.S. Space Command (USSPACECOM) (now part of USSTRATCOM) prepared a policy directive that applies to all branches. According to this policy directive, *Satellite Disposal Procedures (UPD10-39)*, satellites should be disposed of by one of the following five methods. (U.S. Space Command, 2001)

- ***Atmospheric Reentry*** - This method requires maneuvering the satellite to an orbit in which atmospheric drag will cause atmospheric reentry within 25 years of mission completion. If atmospheric reentry is performed by a planned deorbit, it should be planned such that any remaining portions of the satellite will impact the Earth only in non-populated, preferably oceanic areas.

- ***Between LEO and MEO*** - This method requires maneuvering the satellite to an orbit with a perigee altitude above 2,000 kilometers and an apogee altitude below 19,700 kilometers.

- ***Between MEO and GEO*** **-** This method requires maneuvering the satellite to an orbit with a perigee altitude above 20,700 kilometers and an apogee altitude below 35,300 kilometers.

- ***Above GEO*** **-** This method requires maneuvering the satellite to remove it from Earth orbit into a heliocentric orbit.

- ***Direct Retrieval*** **-** This method requires retrieving the satellite and removing it from orbit as soon as is practical after mission completion.

L.4 MDA Activities and Orbital Debris Risk

This section describes the MDA flight test activities that have resulted in or may result in the generation of orbital debris. It discusses how MDA analyzes its activities to identify, assess and mitigate risk, and also describes MDA's participation in on-going governmental debris risk assessment activities.

L.4.1 MDA Activities

Successful flight tests of the BMDS in the exoatmosphere would result in kinetic energy (i.e., hit-to-kill) intercepts that would produce both target and interceptor debris clouds. With the need for increasingly realistic test scenarios, MDA is considering high altitude, high velocity intercept tests. MDA analysis of BMDS flight tests employing ground-launched interceptors shows that the majority (90 to 95 percent) of post-intercept debris reenters the Earth's atmosphere within six hours. A small amount of post-intercept debris may become orbital debris; however, modeling indicates that risk to spacecraft from intercept debris is far lower than the risk posed by existing background debris. Additional efforts are on-going to determine flight test risks in the space environment and resulting potential impacts on orbiting spacecraft.

L.4.2 MDA Risk Analysis

Prior to every BMDS flight test, MDA assesses the risks posed to spacecraft from the post-intercept debris. Launch times are selected to preclude any conjunctions between spacecraft and intercept debris. If necessary, additional analysis is conducted to determine safe launch times within windows thereby minimizing the risks to spacecraft. This analysis allows MDA to determine when to safely conduct a flight test.

A typical BMDS flight test planning process starts approximately 18 to 24 months prior to the mission launch date. The intercept debris risk assessment addresses both surface and space risk areas. Using an intercept debris model designed and verified and validated for hit-to-kill intercepts, the target and interceptor debris clouds are calculated. This model considers the mass properties and engagement conditions (e.g., altitude, velocity, flight path angle). The debris clouds are propagated forward in time and conjunctions

between spacecraft and the intercept debris are identified. Launch times are selected when no conjunctions occur. At times, additional analysis is conducted to determine the probability of impact between spacecraft and intercept debris. This analysis is very thorough and complete. It considers the time and spatial dependence of the intercept debris density, satellite dwell time within the intercept debris field, and satellite area. Once again, launch times are selected when the risk level is low. The MDA works with Air Force Space Command and NASA to make sure all spacecraft are considered including manned spacecraft.

This analysis is performed throughout the entire mission planning process up to the day and hour of launch. It is refined continuously as the mission date nears. Early analyses assist in determining the mission feasibility and aid in mission planning and execution.

It is important to note that both surface and space risk analyses are conducted initially to determine a scenario's feasibility before it is deemed acceptable and the mission planning process starts. If the risks are considered too high (both surface and space), the scenario is redesigned before mission planning ever begins.

L.4.3 MDA Coordination

MDA is participating in the development of an inter-Agency workgroup to ensure that BMDS flight tests are conducted in a manner that permits a thorough and realistic testing of the BMDS while minimizing risk to manned and unmanned spacecraft per the National Space Policy, OSTP, 2006 as implemented by DoD Directive 3100.10. MDA is currently working with NASA, AFSPC, USSTRATCOM, and several other government agencies to establish a safe means to conduct more operationally representative flight tests.

These efforts build upon the current analytic process and inter-Agency coordination procedures as mentioned above. Risks would be assessed for launch window screening to minimize the risk to both manned and unmanned spacecraft with the goal of developing criteria for protecting space assets.

L.5 References

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APPENDIX M
PERCHLORATE TECHNICAL APPENDIX

Foreword

This appendix is not intended to be a stand-alone document or create DoD or MDA policy with respect to perchlorate-related issues. This technical appendix was prepared in response to public comments received on the BMDS PEIS.

This appendix

- Provides an overview of the uses, manufacturing, and disposal of perchlorate for both general commercial purposes and specific MDA or DoD uses;
- Presents DoD's significant contributions to perchlorate detection technology and ongoing research into potential health effects, viable alternatives and treatment methods; and
- Describes health effects and ecological impacts of perchlorate, and the development of an RfD and guidance levels for perchlorate.

This appendix is necessary to support MDA analysis of the potential environmental impacts of BMDS proposed activities, which includes the use of perchlorate as an oxidizer in rocket motors, and to respond to public comments regarding perchlorate that MDA received on the Draft BMDS PEIS.

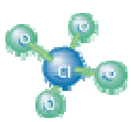
Specifically, public commenters requested that the PEIS

- Address health impacts on susceptible populations including fetuses and children;
- Factor an inhalation pathway for exposure to ammonium perchlorate, including assessments for both public and occupational exposure;
- Present the findings used to support the development of the proposed state guidance levels for perchlorate rather than relying on the findings of the Perchlorate Study Group;
- Include the findings of the NRC of the National Academy of Sciences (NAS) report;
- Include detailed estimates of perchlorate waste likely to be generated by system development, testing, deployment, and decommissioning; and
- Include site-specific analyses of the impacts of perchlorate debris on any freshwater lake or confined ocean areas that might receive perchlorate debris.

PERCHLORATE TECHNICAL APPENDIX

M.1 Introduction

Perchlorate is a common component in a number of commercial industry and government applications. The most common use is as an oxidizer in rocket motors, explosives, and pyrotechnics. Historical disposal practices resulted in the release of perchlorate to the environment. Contemporary concern about perchlorate stems from improved detection capabilities that revealed varying concentrations in ground water. Several human systems, especially the thyroid, have been shown to be sensitive to perchlorate. Historically, perchlorate was once used to treat thyroid disorders in people with a thyroid condition called Graves' disease. This appendix provides a review of the uses, manufacturing, and disposal of perchlorate for both general commercial purposes and specific MDA or DoD uses. It presents DoD's significant contributions to perchlorate detection technology and ongoing research into potential health effects, viable alternatives and treatment methods. Additionally, the appendix describes health effects and ecological impacts of perchlorate, and the development of guidance levels for perchlorate.



Perchlorate (ClO_4^-) is an anion, or negatively charged ion, that originates from both natural and man-made sources. The basic chemical composition of perchlorate consists of an atom of chlorine surrounded by four atoms of oxygen. Perchlorate is manufactured and used as a solid salt compound that typically contains ammonium, potassium, magnesium, or sodium. For this reason, the terms perchlorate and perchlorate salts are used interchangeably and are inclusive of all forms of perchlorate compounds.

Perchlorate is of interest to this analysis because of public concerns over the compound's presence in the natural environment and its potential effects on human health. In 1998, the U.S. Environmental Protection Agency (U.S. EPA) added perchlorate to the contaminant candidate list, which is U.S. EPA's priority list of drinking water contaminants. Contaminants on this list may require regulation and may undergo additional research and data collection before U.S. EPA can determine whether or not a regulation is appropriate. Although U.S. EPA has not determined whether a drinking water standard is appropriate, ground water contamination from the manufacture and disposal of perchlorate-containing chemicals is controversial and of increasing concern to ensure the safety and quality of the nation's water supply. The detection of perchlorate in drinking water systems is attributable to improvements in detection technology capable of measuring levels of perchlorate found in the environment. Technologies that use ion chromatography with preconcentrators or liquid chromatography with mass spectrometry can now detect perchlorate to sub ppb levels. One ppb is equivalent to a single kernel of

corn in a silo measuring 16 feet in diameter and 45 feet high full of corn. See Exhibit M-1 for a comparison of existing perchlorate analytical laboratory methods.

Exhibit M-1. Perchlorate Analytical Laboratory Methods Comparison

Method	Description	Target Reporting Limit	Source
Current U.S. EPA Methods			
Method 314.0	Uses an ion chromatography instrument that includes an anion separator column, an anion suppressor device, and a conductivity detector. Includes alternatives for cleanup (pretreatment) procedures to cope with interfering ions.	0.1 µg/L is target reporting limit for perchlorate in drinking water	U.S. EPA. 1999. "Method 314.0. Determination of Perchlorate in Drinking Water using Ion Chromatography." Revision 1.0. National Exposure Research Laboratory, Office of Research and Development. November.
Method 9058	Uses an ion chromatography instrument that includes an anion separator column, an anion suppressor device, and a conductivity detector.	4 µg/L is Limit of Quantitation (LOQ). Method detection limit is 0.7 µg/L in ground water.	U.S. EPA. 2000. "Method 9058. Determination of Perchlorate using Ion Chromatography with Chemical Suppression Conductivity Detection." Revision 0. SW-846 Update IVB. November.
Method 314.1	Uses a preconcentrator to remove common interferents, including chloride, carbonate, and sulfate. In addition, provides for use of a second column to confirm identity of perchlorate.	0.5 – 1 µg/L	U.S. EPA. 2005e. "Determination of Perchlorate in Drinking Water Using Inline Column Concentration/Matrix Elimination Ion Chromatography with Suppressed Conductivity Detection." Document number 815-R-05-009. Revision 1.0. May. http://www.epa.gov/safewater/methods/pdfs/method_314_1.pdf.
Method 331.0 – "Determination of Perchlorate in Drinking Water by Liquid Chromatography Electrospray Ionization Mass Spectrometry"	Uses a different chromatographic method to separate perchlorate from other ions, which may be more effective in reducing interference. Tandem mass spectrometry provides a tool to eliminate sulfate interference. The method quantitates perchlorate against an isotopically labeled (oxygen-18) internal standard. This method may provide versatility needed for difficult matrices.	0.02 µg/L	U.S. EPA. 2005f. "Determination of Perchlorate in Drinking Water by Liquid Chromatography Electrospray Ionization Mass Spectrometry." Document number. Revision 1.0. Document number 815-R-05-007. January. http://www.epa.gov/safewater/methods/met331_0.pdf Accessed January 2006.
Method 332.0 – "Determination of Perchlorate in Drinking Water Using Ion Chromatography with Suppressed Conductivity	Substitutes an electrospray ionization mass spectrometry (ESIMS) detector for the conductivity detector of Method 314.0. Provides confirmation of identity of perchlorate or definite evidence of false positive results from interferents. Can handle relatively high	0.1 µg/L Ion Chromatography/Mass Spectrometry (IC/MS) and 0.02 µg/L (IC/MSMS)	U.S. EPA. 2005g. "Determination of Perchlorate in Drinking Water Using Ion Chromatography with Suppressed Conductivity and Mass Spectrometric Detection." Revision 1.0. Document number EPA/600/R-05/049. March. http://www.epa.gov/nerlcwww/m_332_0.pdf, accessed January 2006.

Method	Description	Target Reporting Limit	Source
and Mass Spectrometric Detection”	concentrations of total dissolved solids.		
Methods Under Development			
Method 6850 – “Determination of Perchlorate Using High Performance Liquid Chromatography/ Mass Spectrometry”	Uses the technology of Method 331.0 to separate perchlorate from other ions and the technology of Method 332.0 to confirm the identity of perchlorate and quantitate it.	Practical quantitation limits (PQL) are 0.2 µg/L for water (drinking water, simulated ground water, and Great Salt Lake water), 2 µg/L for soil, and 6 µg/L for biota (grass). Method detection limits are about 1/3 of the PQLs.	U.S. EPA. 2004b. E-mail message regarding perchlorate analysis. From Mike Carter, (EPA Federal Facilities Restoration and Reuse Office) to John Quander. July 14.
“Rapid Determination of Perchlorate Anion in Foods by Ion Chromatography – Tandem Mass Spectrometry”	Developed in support of an ongoing program for collection and analysis of foods to measure perchlorate content. Samples are extracted by food-specific methods. Extracts are then separated by ion chromatography as in Method 332.0 and determined by the technology (including the internal standard) used in Method 331.0.	LOQs are 0.5 µg/L for drinking water, 1 µg/L for fruits and vegetables, and 3 µg/L for milk	FDA. 2004. “Draft Rapid Determination of Perchlorate Anion in Lettuce, Milk, and in Bottled Water by HPLC/MS/MS.” Revision 0. Dated March 17. Downloaded July 15 from http://www.cfsan.fda.gov/~dms/clo4meth.html.
Field Screening Method for Perchlorate in Water and Soil	A field screening colorimetric method for perchlorate was developed by the U.S. Army Corps of Engineers (USACE). This method was published as a report (ERDC/CRREL TR-04-8), which is available for download at http://www.crrel.usace.army.mil/techpub/CRREL_Reports/reports/TR04-8.pdf.	Detection limits: 1 µg/L for water; 0.3 µg/g for soil	USACE. 2004. Field Screening Method for Perchlorate in Water and Soil. U.S. Army Engineer Research and Development Center (ERDC)/Cold Regions Research and Engineering Laboratory (CRREL) TR-04-8. April.

Source: Environmental Protection Agency, Office of Solid Waste and Emergency Response (OSWER): Perchlorate Treatment Technology May 2005 (EPA 542-R-05-015) http://www.clu-in.org/download/remed/542-r-05-015.pdf

While perchlorate has been detected in the drinking water of 35 states plus Puerto Rico and the Mariana Islands, the apparent absence of perchlorate in other regions may be due to the small number of sampled areas. (U.S. EPA, 2005d)

The U.S. EPA is responsible for establishing Federal drinking water standards where this is considered appropriate. Several Federal agencies initiated collaborative research efforts to better understand the fate, effects, and potential remediation strategies for perchlorate in the environment. This effort was initially coordinated by the Interagency

Perchlorate Steering Committee (IPSC), followed in 2002 by the establishment of the Perchlorate Interagency Working Group (IWG). The IWG is coordinated by the Office of Management and Budget and the Office of Science and Technology Policy and includes several agencies – White House CEQ, U.S. EPA, DoD, NASA, Department of Health and Human Services, and Department of the Interior.

Because of data limitations and controversies regarding the interpretation of the research results on perchlorate in U.S. EPA's draft perchlorate risk assessments, the IWG asked the NRC of the NAS to independently assess the state of the science regarding potential thyroid disruption, levels of chronic inhibition of iodine uptake that lead to adverse effects, and levels at which changes in thyroid hormones lead to adverse effects. The NRC was also tasked to review the scientific literature and findings from the U.S. EPA's 2002 draft risk assessment, *Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization*.

The NRC study recommended an RfD of perchlorate of 0.0007 mg/kg per day.[1] The NRC stated that this value is supported by clinical studies, epidemiologic studies, and studies of long-term perchlorate administration. The NRC report concluded that the proposed RfD of 0.0007 mg/kg per day should protect even the most sensitive populations. The U.S. EPA established a reference dose of 0.0007 mg/kg per day of perchlorate in its Integrated Risk Management System based on the NRC report. Doses below the RfD are considered safe. Doses exceeding the RfD will not necessarily lead to adverse effects as there are uncertainties incorporated into the calculation of the RfD. The possibility that adverse effects might occur increases the higher the dose is above the RfD.

M.2 Use and Manufacturing

Commercial industry and government entities use perchlorate for many applications. Perchlorate currently is used in approximately 250 types of munitions (approximately 14 percent) used by DoD today. The most common application is as an oxidizer in rocket motors, explosives, and pyrotechnics. Section M.3 discusses other industrial uses of perchlorate. It is estimated that 92 percent of perchlorate is sold for end-use as an oxidizer in solid rocket fuel, 7 percent as an explosive, and 1 percent for other uses. (Crowley, 2004) Oxidizers are the compounds that release oxygen to support a combustion reaction. The high ignition temperature, controllable burn rate, and stable chemical characteristics of perchlorate make it one of the most efficient and reliable materials currently available for use as an oxidizer. (DoD, 2005a)

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[1]The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a no observed adverse effect level (NOAEL), lowest observed adverse effect level (LOAEL), or benchmark dose, with uncertainty factors generally applied to reflect limitations of the data used.

All military services (Air Force, Army, and Navy) use munitions, ordnance, etc. that contain perchlorate at the following types of facilities: ammunition plants, research laboratories, depots, proving grounds, testing facilities, rocket maintenance facilities, and training bases. (DoD, 2005a)

The principal ingredient in solid rocket propellant is ammonium perchlorate (a perchlorate salt), making the DoD and NASA the largest users of this type of perchlorate in the U.S. (DoD, 2005b; Aerospace Corporation, 2002) In fact, more ammonium perchlorate is used for solid rocket fuel production than for all other perchlorate uses combined. (AWWA, 2005) The GBI, Standard Missile-3, THAAD missile, PAC-3 missile, and the KEI under development are MDA missiles that use solid propellants containing perchlorate.

Of the four perchlorate salts listed in Exhibit M-2, ammonium perchlorate is the most commonly used. Although the four perchlorate salts have similar effects once introduced into the environment, they have distinctly different uses as outlined in Exhibit M-2.

Exhibit M-2. Military and Commercial Uses of Perchlorate Salts

Type of Perchlorate	Uses
Ammonium (NH_4ClO_4)	Solid rocket fuel oxidizer, flares, explosives, pyrotechnics, and chemical processes
Potassium ($KClO_4$)	Solid rocket fuel oxidizer, flares, air bag inflation systems, pyrotechnics such as fireworks, training simulators, hand grenade delays, aircraft countermeasures, and detection of defects in thyroid function (medical use)
Magnesium ($Mg(ClO_4)_2$)	Military batteries
Sodium ($NaClO_4$)	Slurry explosives, electro-machining, and chemical processes (precursor to potassium and ammonium perchlorate)

Source: American Pacific Corporation, 2005; California EPA, 2004; DoD, 2005; NRC, 2005; Greer et al., 2002; U.S. EPA, 2002

In the U.S., two companies began full-scale commercial production of perchlorate-containing chemicals in the 1940s, with combined production volumes ranging from 1 to 15 million pounds per year. (U.S. EPA, 2002) Production peaked in the 1980s with volumes of 20 to 30 million pounds per year. (U.S. EPA, 2002) Annual production volumes have been decreasing from 16.4 million pounds of Grade I ammonium perchlorate in 2002 to between 10 million and 11 million pounds in 2004. (Crowley, 2004) In 2003, NASA's Space Shuttle program used a little more than half of the ammonium perchlorate produced and DoD (including MDA) used the majority of the remaining ammonium perchlorate produced that year.

M.3 Other Sources of Perchlorate

Although military uses account for much of the perchlorate produced and used, other sources exist including those derived from

- Storage, handling, and use of Chilean nitrate-based fertilizers containing perchlorate;
- Manufacturing, storage, handling, use, and/or disposal of fireworks containing perchlorate;
- Manufacturing, storage, handling, use, and/or disposal of road flares containing perchlorate;
- Manufacturing, storage, handling, use, and/or disposal of explosives or pyrotechnics containing perchlorate; and
- Manufacturing, storage, handling, and use of electrochemically-prepared chlorine products (primarily those that contain chlorate or were manufactured from chlorate feedstocks). (SERDP, 2005)

Chilean Nitrate Fertilizer: Records show that between 1909 and 1929, the U.S. imported an estimated 19 million tons of Chilean nitrate (Goldenwieser, 1919 and Howard, 1931, as cited in SERDP, 2005), 65 percent of which was used as fertilizer. (Brand, 1930, as cited in SERPD, 2005) U.S. EPA research found an average perchlorate content in Chilean nitrate of about 0.2 percent. Using this average, approximately 49 million pounds of perchlorate may have been unknowingly applied to agricultural crops during this time. (SERDP, 2005) The use of Chilean nitrate fertilizer has declined but it is still used in limited quantities. (SERDP, 2005) The "Santa Ana Regional Water Quality Board officials have recently acknowledged that a major source of perchlorate pollution in some Southern California drinking water supplies may be the Chilean nitrate fertilizer that was applied to the region's citrus crops for decades into the early 20th century. (Press Enterprise Company, 2004)

Fireworks: In 2003, 221 million pounds of fireworks were consumed in the U.S. (SERDP, 2005) Perchlorate is used as an oxidizer in fireworks; however, there is little information related to the amount of perchlorate residue remaining after burning fireworks or on the number of dud fireworks used. Therefore, it is difficult to estimate potential perchlorate inputs from fireworks to the environment. Recent studies have detected perchlorate in soils, ground water and/or surface water following fireworks displays. (SERDP, 2005)

Safety Flares: Preliminary research indicates that 3.6 grams of perchlorate can potentially leach from an unburned, damaged (e.g., run over by a motor vehicle) 20-minute road flare. It has been estimated that some 20 to 40 million flares may be sold annually. Given this estimate, up to 237,600 pounds of perchlorate could leach from road flares annually. (SERDP, 2005) Studies have shown that one unburned flare can leach up to 243,000 ppb of perchlorate when in contact with 15 liters of water for 3.5 hours. This

could be enough to contaminate up to 2.2 acre-feet of water to 4 ppb. Under similar conditions, even completely burnt flares released perchlorate at rates up to 130 ppb per flare. (DoD, 2005b)

Blasting Explosives: Some explosives can contain substantial amounts of perchlorate (e.g., up to 30% by weight). Most of the perchlorate would be consumed during the detonation; however, spills, improper use, or misfires could potentially result in contamination of surface and ground water. (SERDP, 2005)

Chlorine Chemicals: During the electrochemical manufacture of chlorine products, such as chlorate, perchlorate may be formed as an impurity at concentrations of 50 to 500 mg/kg. The North American annual chlorate manufacturing capacity is estimated at 2.4 million tons, and the total annual consumption of sodium chlorate in the U.S. is approximately 1.2 million tons. (SERDP, 2005) The pulp and paper industry uses approximately 94% of all sodium chlorate consumed in the U.S. and effluents from pulp mills have been reported to contain chlorate (1 to 70 milligrams per liter). (SERDP, 2005) However, there is little information about the potential for perchlorate release from these facilities. Sodium chlorate is also used as an herbicide and defoliant for cotton, sunflowers, sundangrass, safflower, rice, and chili peppers. (SERDP, 2005)

Natural Sources: Tests conducted by Texas Tech University suggest that there is a natural flux of atmospheric perchlorate to the Earth as well as a natural perchlorate level. (Environmental Science and Technology Online News, 2005) With improved detection methods researchers have found low levels of perchlorate in many locations. The Texas Tech study found highly variable data ranging from levels too low to detect to levels measuring in the ppb. (Environmental Science and Technology Online News, 2005) The specific reasons for this variability were not determined and follow on studies have been proposed.

Exhibit M-3 shows the current and historical uses of perchlorate.

Exhibit M-3. Current and Historical Uses of Perchlorate

Raw Product	Product/Process	Role of Perchlorate in the Product/Process
Perchlorate Salts	Ammonia production	Ingredient of catalytic mixtures used in making ammonia
	Detonating compositions	Oxidizing Agent
	Matches	Oxidizing Agent
	Pyrotechnic compositions	Oxidizing Agent
	Railroad signal (fuse) compositions	Oxidizing Agent
	Smoke-producing compounds	Oxidizing Agent
	Metallurgical	Constituent of brazing fluxes, welding fluxes
	Pharmaceutical	Used in compounding and dispensing practice
	Air bags for vehicles	Initiators
	Paints and enamels	Curing/Drying Agent
	Photography	Flash powder/ oxidizing agent
	Oxygen generators	Burn Rate Modifier
	Road flares	Oxidizing Agent
	Ejection seats	Propellant
	Model rocket engines	Propellant
	Rockets used for research, satellite launches, and Space Shuttle	Propellant
	Some explosives in construction, mining and other uses	Oxidizing Agent
	Fireworks	Oxidizing Agent
	Voltaic cells and batteries involving lithium or lithiated anodes, non-aqueous solvents or polymeric films, and manganese dioxide or other transition metal oxides	Electrolyte (Lithium perchlorate)
	Zinc and magnesium batteries	Electrolytes (Zinc perchlorate and magnesium perchlorate)
	Electropolymerization reactions involving monomers such as aniline, benzidine, biphenyl, divinylbenzene, and indole	Electrolyte
	Polyvinyl chloride	Dopants to improve heat stability and fire retardation characteristics
	Thin film polymers such as polyethylene oxide, polyethylene glycol, or poly (vinylpyridine)	Dopant to impart conductive properties in various electrochemical devices
	Drying agent for industrial gases and other similar applications	Desiccant (Anhydrous magnesium perchlorate)
	Plastics and polymers	Dopants to impart antistatic and conductive properties
Perchloric Acid	Nitrogen measurement	Used for Kjeldahl digestions
	Leather tanning	Extraction of chromium

Raw Product	Product/Process	Role of Perchlorate in the Product/Process
	Potash measurement	Used to form insoluble potassium perchlorate
	Manufacture of inorganic chemicals, intermediates, organic chemicals, pharmaceuticals, synthetic aromatics	Oxidizing Agent
	Manufacture of explosive compounds, such as the perchlorated esters of monochlorohydrin.	Reagent
	Ingredient of lead-plating baths	Facilitates the deposition of lead from baths containing lead perchlorate
	Electropolishing operations	Electrolyte in anodization of metals to produce non-corroding surfaces
	Metallurgy	Extraction of rare earth metals
	Etching brass and copper	Acid
	Acetylations, alkylations, chlorinations, polymerizations, esterifications, and hydrolyses	Catalyst
	Cellulose acetate production	Esterification of cellulose
	Destruction of organic matter, especially in preparation for the determination of calcium, arsenic, iron, copper, and other metals	Acid digestion, in combination with nitric acid
	Determination of copper and other metals in sulfide ores	Acid digestion
	Dissolving refractory substances such as titanium slags	Acid digestion
	Ammonium perchlorate, high purity metal perchlorates	Starting material for the manufacture of pure ammonium perchlorate and in the production of high purity metal perchlorates
	Pickling and passivation of iron and steels	Oxidant
	Determination of silica in iron and steel and in cement and other silicate materials	Dehydrating Agent
	Determination of chromium in steel, ferrochrome, chromite, leather, and chromatized catgut	Oxidizing Agent
	Separation of chromium from other metals by distillation of chromyl chloride	Used in combination with hydrochloric acid
	As a primary standard acid	Perchloric acid, when distilled in a vacuum at a carefully regulated pressure, has exactly the composition of the dihydrate, 73.6% $HClO_4$
	Indirectly in the manufacture of anhydrous magnesium perchlorate	Dehydrating Agent

Raw Product	Product/Process	Role of Perchlorate in the Product/Process
	Titration of bases in non-aqueous solvents	As the strongest of the strong acids dissolved in anhydrous acetic acid
	Analytical procedures for the destruction of organic matter prior to the determination of metallic and non-metallic ingredients such as: • Determination of sulfur in coal, coke, and oils; • Determination of iron in wine, beer, and whiskey; • Determination of chromium and of iron in leather and tanning liquors; • Determination of phosphorus, alkali metals, lead, and other ingredients; and • Analysis of blood for calcium and of urine for lead.	Destruction of organic matter (mixtures of perchloric acid dihydrate with nitric acid or sulfuric acid, or of these three acids together)
Chilean Sodium Nitrate	Fertilizers	Incidental ingredient in fertilizers (largely historical, but soils previously treated may still contain perchlorate)
	Charcoal briquettes	Naturally occurring by-product
	Meat tenderizers	Naturally occurring by-product

Source: SERDP, 2005

M.4 Disposal

As seen in Exhibit M-3, perchlorate can enter the environment through a variety of sources including: solid rocket propellant, Chilean nitrate fertilizers, fireworks, safety flares, blasting explosives, and electrochemically-prepared chlorine products. However, the discussion on disposal of perchlorate in this appendix focuses on the disposal of perchlorate generated by DoD activities.

Perchlorate is most commonly used in solid rocket propellant. Solid rocket propellant has a finite shelf life and periodically must be replaced. Consequently, a large amount of ammonium perchlorate has been disposed of since the 1950s. For example, the SRM fuel used in the GBIs has a planned shelf life of approximately 20 years. However, the solid rocket fuel contained in the Minuteman missiles has remained viable for 32 years. The specific chemical composition of the SRM propellant and the environmental conditions (temperature and humidity) of the storage area influence the shelf life of the SRM propellant. (California EPA, 2004)

Although the exact amounts of perchlorate disposed of are not available, the number of pounds of SRM requiring disposal has been reported. In 1998, the U.S. had 55 million pounds of SRM propellant requiring disposal. This amount is projected to grow to over 164 million pounds by the end of 2005. (U.S. EPA, 2002) The Minuteman III Propulsion

Replacement Program will remove over 35 million pounds of propellant from 1,200 first and second stage motors to recover and reuse the motor cases. (ESTCP, 2000)

Most of the perchlorate that has been found in ground water is due to past disposal practices that are no longer used today. Past disposal methods for solid rocket propellant included open-burning, open-detonation, or static (stationary) firing of SRMs as well as dumping off-specification batches of solid propellant. In some isolated past practices, the wastewater was discharged into unlined waste ponds. Many areas where perchlorate has been detected in ground water are located near weapons and rocket fuel manufacturing facilities and disposal sites, research facilities, and military bases. (DoD, 2005a)

The Services have prepared various directives and instructions regarding the responsibility of safely managing munitions and rocket engines. For example, as discussed in OPNAV Instruction 8026.2A, Navy Munitions Disposition Policy (15 June 2000), DoD Directive 5160.65 (Nov 81), "Single Manager for Conventional Ammunition," designated the Secretary of the Army as the Single Manager for Conventional Ammunition (SMCA). The SMCA is assigned responsibility for demilitarization, recycling, declassification and disposal of all munitions (SMCA and non-SMCA managed) except large strategic missile rocket motors. The Director, Strategic Systems Programs (DIRSSP) is responsible for Navy large strategic missile rocket motor demilitarization, reclamation, declassification and disposal.

These directives and instructions prohibit many of the past disposal practices and have established DoD's preferred hierarchy of demilitarization and disposal techniques for minimizing environmental, health and safety impacts.

- Complete reuse or recycling of system components and materials,
- Reprocessing system components and materials into a useful format,
- Sale or donation to the private sector and other governments, and
- Waste disposal (as a final resort).

At MDA and throughout DoD, significant effort is expended in reusing excess or surplus rocket engines by providing them to one of the Services for use as target vehicles or lift vehicles. In fact, a significant portion of the target vehicles acquired by MDA are obtained from the Services. This practice prevents the excess or surplus rocket engine from becoming a waste that would need to be managed.

In cases when a Service cannot use the rocket engine, as is the case in some rocket engine remanufacturing or demilitarization programs, the rocket engine might be destroyed using controlled firings or the rocket popellant washed out of rocket motor casings using high-pressure water or other techniques such as cryogenic removal. Although some of these processes might generate wastewater streams containing dissolved rocket

propellant, they are handled and managed in accordance with appropriate wastewater regulations.

Specifically, non-hazardous wastewaters are handled as industrial wastewaters that are treated in wastewater treatment plants. Wastewaters that might exhibit one of the characteristics of a hazardous waste under the Resource Conservation and Recovery Act (RCRA) are treated and disposed of in a RCRA Subtitle C facility or are discharged via a National Pollution Elimination Discharge System permitted outfall. (ESTCP, 2000) Likewise, solid waste streams are handled in accordance with either the industrial waste (Subtitle D) regulations or the hazardous waste (Subtitle C) regulations to safely manage and prevent the introduction of hazardous constituents into our environment. The waste handling requirements of RCRA ensure the public is protected from the hazards of waste disposal, and that any wastes that may have been spilled, leaked or improperly disposed are cleaned up. (ESTCP, 2000; Motzer, 2003; U.S. EPA, 2004)

M.5 Department of Defense Efforts

The DoD has been a leader in perchlorate-related research. The DoD developed and contributed to establishing technologies that detect perchlorate at extremely low levels. Prior to 1997, the lowest detection level was 400 ppb. Through cooperation with DoD, U.S. EPA approved a method, Method 314.0, that allows detections as low as 1- 4 ppb.[2] The state of California started using a 4 ppb detection limit prior to the approval of U.S. EPA Method 314.0. Following the detection of these lower levels, DoD and other Federal and state authorities formed the IPSC. The Committee assembled the leading perchlorate specialists to coordinate efforts to better understand the occurrence, health effects, treatability and waste stream handling, analytical detection, and ecological impacts of perchlorate contamination in drinking water and irrigation water supplies. The IPSC aimed to address public concerns about perchlorate and to provide real-time information on the issue. Its collaborative efforts continue under the 2002 IWG that funded the 2005 independent review of the perchlorate issue by the NRC.

In 2000, DoD formed the Perchlorate Workgroup to coordinate internal perchlorate research and technology development. Through the Workgroup, DoD cooperates with Federal, state, and local officials and host communities to effectively address perchlorate concerns at active, base realignment and closure (BRAC) sites, and Formerly Used

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[2] The original perchlorate detection method, EPA Method 314.0, was based on ion chromatography with a conductivity detector. There have been concerns about the potential for both false positive and false negative identifications as well as this methods ability to reliably detect and quantitate low concentrations. The Office of Water has now published several new perchlorate methods using either ion chromatography or liquid chromatography coupled to a mass spectrometer detector which results in identifications that are extremely reliable. (See Exhibit M-1.) In addition, the Office of Solid Waste is developing analogous mass spectrometer methods applicable to soil, sediment and waste samples that are also very sensitive with measurement capabilities in the parts per trillion range.

Defense Sites. The Workgroup's mission is to provide for further research into the actual extent of perchlorate in ground and surface water, pollution prevention measures, safe and effective alternatives to perchlorate, potential health effects from chronic, low-level perchlorate exposure in drinking water, ecological effects, and suitable treatment technologies. To date, DoD has spent over $59 million on efforts including: investigations into perchlorate sampling and analysis, identifying and evaluating innovative and cost-effective remediation technology, applying pollution prevention principles to minimize and eliminate perchlorate waste streams, and finding alternatives to perchlorate in munitions. MDA continues to follow DoD policy and guidance regarding the sampling and analysis of perchlorate.

The DoD's action plan reflects a commitment to protect public health and the environment by

- Sampling for perchlorate;
- Establishing priorities for sampling and monitoring that reflect the most sensitive exposure pathways;
- Monitoring and determining appropriate actions to prevent migration of perchlorate into drinking water supplies;
- Incorporating Federal or state regulatory standards, whichever are more stringent, into the DoD's clean up program once standards are established for perchlorate; and
- Preventing pollution and investing in finding substitutes for the various military uses of perchlorate that will have less public health and environmental concerns. (SERDP, 2005)

Perchlorate Recycling Efforts

In December 2002, the Army established a missile recycling center at Anniston Army Depot in Alabama. This recycling center enables the Army to safely dispose of obsolete and over-aged tactical missiles in an environmentally responsible manner. The Army estimates that 600,000 outdated missiles at ammunition storage sites and plants across the country and overseas need to be recycled over the next 10 to 15 years. The Army estimates that 98 percent of the missile hardware, warhead explosives and propellant ingredients can be reused or recycled into various industrial or military applications. The current recycling production rate at this facility is approximately 15,000 missiles annually. The Army hopes to be able to recover over 80 million pounds of ammonium perchlorate to be used in new military munitions or converted into various industrial products including potassium perchlorate (used by the air bag industry), perchloric acid, and other specialty chemicals. (DoD, 2005a)

Researching Alternatives to Perchlorate

DoD is currently evaluating alternatives to perchlorate in munitions. For example, the Army is in the process of replacing perchlorate in two training simulators which are responsible for the majority of the perchlorate expended (fired) on Army training ranges today. The M115A2/Ground Burst projectile simulator and the M116A1/Hand Grenade Simulator expend approximately 10.8 tons of perchlorate per year for training. The perchlorate is consumed when the simulators are used; however, concern over the integrity of the cardboard casing in the rain, and the chance of incomplete consumption of the perchlorate led the Army to replace the perchlorate composition as a precautionary measure. The Army expects to have the replacement simulators fielded and operational by 2006. (DoD, 2005a)

Other examples of replacement efforts include potential alternatives for rocket and missile propellants, smoke formulations for rockets, and flares and signals. The DoD carefully weighs safety, cost, and potential for contamination when determining which munitions to target for perchlorate replacement. (DoD, 2005a)

M.6 Human Health Effects

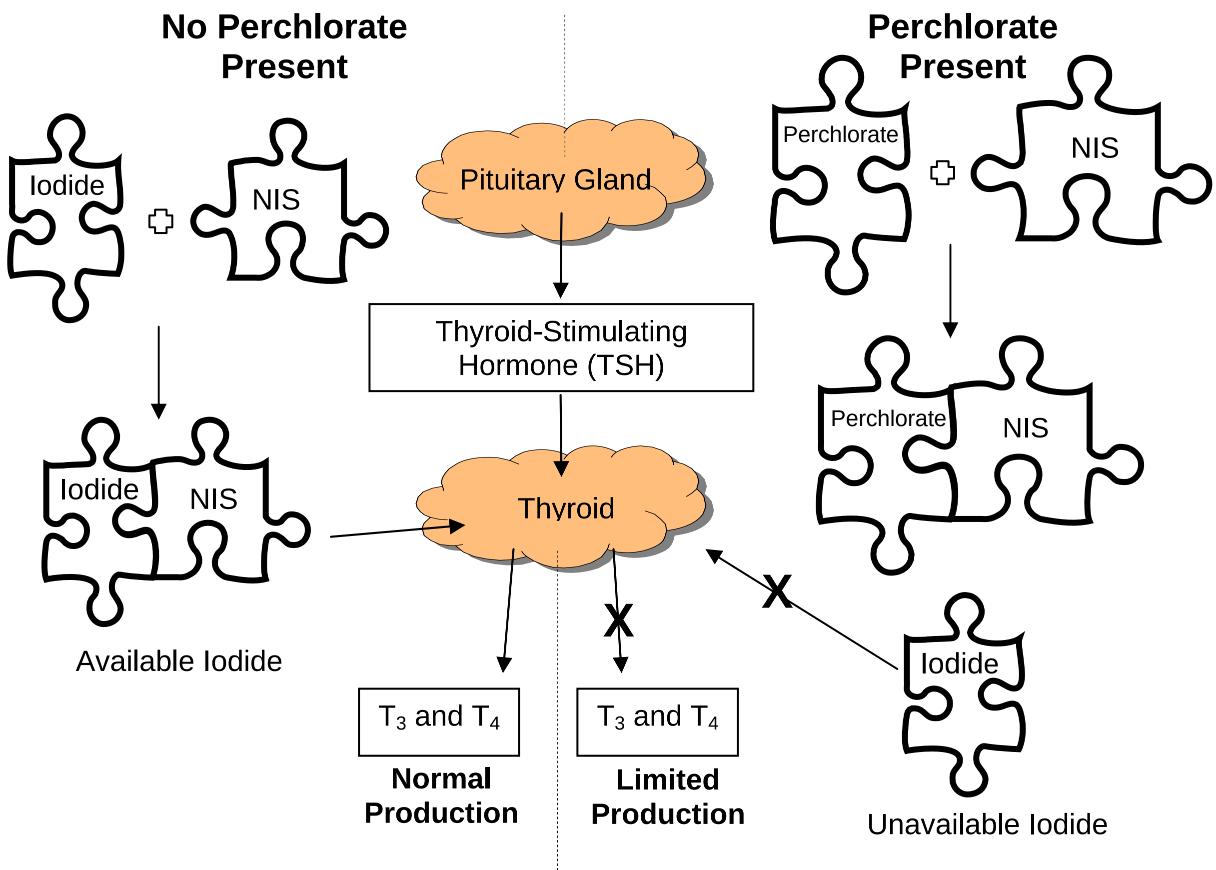
Detection of perchlorate in drinking water is critical to evaluating human health and ecological effects. This section of the appendix presents a general review of the thyroid gland, one of the more perchlorate-sensitive human systems, and discusses the effects of perchlorate exposure on the thyroid and non-thyroid related functions. MDA reviewed numerous scientific studies on the effect of perchlorate on the thyroid gland and on other human systems, as well as epidemiological (population studies) and animal toxicology studies. The primary literature reviewed by MDA included U.S. EPA's draft risk assessment Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization (2002), and the NRC report entitled Health Implications of Perchlorate Ingestion (2005). The NRC of the NAS was asked to assess independently the adverse health effects of perchlorate ingestion from clinical, toxicological, and public-health perspectives. They were also asked to evaluate the relevant scientific literature and key findings underlying U.S. EPA's 2002 draft risk assessment. In response to the request, the NAS convened the Committee to Assess the Health Implications of Perchlorate Ingestion and published their comprehensive report in January 2005.

M.6.1 Thyroid Function

Current research demonstrates that the human thyroid gland is one of the more sensitive glands affected by perchlorate. The thyroid gland converts iodide, found in many foods that we eat, into thyroid hormones [thyroxine (T_4) and triiodothyronine (T_3)], which aid in regulating metabolic rates throughout the human body. Perchlorate affects the way that iodide is transported into various glands and systems throughout the body. For iodide to enter the thyroid and other glands and systems, it must bind to another

molecule, sodium (Na^+)/iodide (I^-) symporter or "NIS." Perchlorate has a similar shape and electric charge as iodide and readily binds with NIS. When NIS is bound to other non-iodide ions (perchlorate), the transport of iodide into the thyroid and other glands is inhibited. Exhibit M-4, Thyroid Hormone Production with and without Perchlorate Present, graphically displays what happens when perchlorate is present in the human body.

Exhibit M-4. Thyroid Hormone Production with and without Perchlorate Present



Proper thyroid function depends on the balance of the negative feedback loop of the hypothalamic-pituitary-thyroid (HPT) axis. The hypothalamus produces thyrotropin-releasing hormone (TRH) that travels to the pituitary gland and stimulates the synthesis of thyroid stimulating hormone (TSH). TSH initiates a series of transduction signals resulting in the synthesis and release of T_3 and T_4. Homeostasis is maintained by an endocrine negative feedback loop; increased circulating levels of T_3 and T_4 lead to a decrease in TRH and TSH secretions resulting, in turn, in decreased thyroid gland activity; conversely, decreased T_3 and T_4 levels in systemic circulation result in an increase in TRH and TSH secretions that stimulate the thyroid gland to increase its activities to synthesize and release additional T_3 and T_4 requires both the presence of sufficient iodide as well as TSH released from the pituitary gland. Feedback regulation

through changes to TSH levels protects against both hypothyroidism (deficiency of thyroid hormone) and hyperthyroidism (excess of thyroid hormone). The presence of perchlorate at sufficient doses can inhibit iodide uptake to the thyroid, eventually reducing thyroid hormone levels (T_3, T_4) if maintained for a prolonged period of time at a sufficient level to exceed thyroid compensatory mechanisms, such as the increased TSH production. The T_3 and T_4 thyroid hormones are responsible for regulating the body's metabolic rate, but also for stimulating the development and growth of many kinds of cells throughout the body including in the brain and central nervous system.

As shown in Exhibit M-4, when the transport of iodide into the thyroid is inhibited, there is a decrease in the production of T_4 and T_3. If, in spite of TSH-induced increases in thyroid function, the amount of iodine is still insufficient to keep up with the body's hormone demand, the serum thyroid hormone levels will decrease. For adverse health effects to occur in otherwise healthy adults, thyroid hormone production would likely have to be reduced by at least 75% for months or longer. (NRC, 2005) In sensitive populations (pregnant women, infants, children, and people with low iodide intake or thyroid dysfunction) the dose required to cause hypothyroidism may be lower. However, data are not available to determine the precise level of decreased production that would cause adverse health effects in those sensitive populations.

Humans obtain iodide by ingestion of food or water that contains it. The human body is able to compensate for iodide deficiency; therefore, thyroid hormone production is generally normal even when iodide intake is quite low. Hypothyroidism occurs only if daily iodide intake is below about 10 to 20 grams (about one-fifth to one-tenth of the average intake in the U.S.). However, iodide deficiency of that severity in pregnant women can result in neurodevelopmental deficits and goiter in their children. Lesser degrees of iodide deficiency may also cause significant neurodevelopmental deficits in infants and children. (NRC, 2005)

M.6.2 Perchlorate and the Thyroid

As described in Section M.6.1, perchlorate replaces iodide and results in a decrease of the normal production of thyroid hormones T_4 and T_3. To understand the effect of perchlorate ingestion on the thyroid, it is necessary to equate the concentration of perchlorate in drinking water with a daily intake level, in milligrams for example, to relate the concentration of perchlorate in each test to an amount that would need to be consumed.

The exposure factors established by U.S. EPA for converting a health-based dose level to a drinking water concentration were used to convert a daily dose of perchlorate (e.g., 10 milligrams) to a concentration of perchlorate in ground water (e.g., 5 milligrams (mg) per liter or 5 parts per million [ppm]). (U.S. EPA, 1997) The U.S. EPA-established methodology assumes that healthy adults weigh 70 kg (154 pounds) and drink 2 liters

(approximately 0.5 gallon) of water per day. Based on the above example, 10 mg per day times 1 day per 2 liters equals 5 mg per liter, as displayed below.

$$\frac{10\text{ mg}}{1\ \cancel{\text{day}}} \times \frac{1\ \cancel{\text{day}}}{2\text{ liters}} = \frac{5\text{ mg}}{\text{liter}} \qquad 5\text{ ppm }(5{,}000\text{ ppb})$$

The dose of perchlorate (in mg/kg per day) is multiplied by a standard body weight of 70 kg and divided by the number of liters (2 liters) that an adult consumes per day. This converts the concentration of the daily dose into mg per liter, which is approximately equivalent to ppm. For doses of perchlorate that are provided in mg/kg of body weight, the dose is multiplied by the body weight (70 kg) to calculate the total daily dose of perchlorate and equate a comparative ground water contamination. Exhibit M-5, Correlation of Doses and Concentration, presents the concentration of perchlorate in ground water in mg per liter, ppm, and ppb that would be necessary to achieve such a dose.

Exhibit M-5. Correlation of Doses and Concentration

Human and Animal Health Studies		**Groundwater Concentration**		
Dose (mg per day)	**Dose (mg/kg of body weight)**	**mg/liter**	**ppm**	**ppb**
0.001	0.000014	0.0005	0.0005	0.5
0.01	0.00014	0.005	0.005	5
0.05	0.0007	0.025	0.025	25
0.1	0.0014	0.05	0.05	50
0.5	0.007	0.25	0.25	250
1	0.014	0.5	0.5	500
10	0.14	5	5	5,000
100	1.4	50	50	50,000
250	3.6	125	125	125,000
500	7.14	250	250	250,000
1,000	14.3	500	500	500,000
5,000	71.4	2,500	2,500	2,500,000
10,000	142.9	5,000	5,000	5,000,000

U.S. EPA is responsible for setting appropriate drinking water standards. U.S. EPA makes these determinations based on hazard and exposure information and whether or not regulation of perchlorate would provide a meaningful opportunity for health risk reduction. MDA has reviewed available studies in which perchlorate was given to patients with hyperthyroidism and healthy subjects over various amounts of time to

determine the effects on thyroid function. As a caveat to the information provided below, it should be noted that the NRC indicated that there is no information on the effects of low level iodide uptake inhibition on iodide-deficient, hypothyroid or borderline hypothyroid pregnant women or neonates. The dosage estimates provided relate to healthy adults who are both euthyroid and iodide replete (see Greer et al., 2002) or to seriously hyperthyroid states followed by maintenance therapy under presumably normal iodide intake levels. Early medical literature during the 1950s and 1960s contained reports of successful treatment of more than 1,000 hyperthyroid patients with high levels of potassium perchlorate (between 400 and 2,000 milligrams per day) for many weeks or months. These dose values correspond to estimated drinking water concentrations (EDWCs)[3] of 200,000 to1,000,000 ppb. Among the patients were 12 pregnant women who had hyperthyroidism and were treated with 600 to 1,000 mg of potassium perchlorate per day (EDWCs: 300,000 to 500,000 ppb). One infant had slight thyroid enlargement that decreased soon after birth. No other abnormalities were reported in the infants. However, no thyroid function tests or neurodevelopmental evaluations were conducted, and the infants did not receive any follow up medical evaluation.

Perchlorate also was used in the 1950s and 1960s to treat hyperthyroidism associated with Graves' disease.[4] Perchlorate was not widely used to treat this disorder, and its use was curtailed when severe hematologic side effects were noticed including aplastic anemia[5] and agranulocytosis[6], and when better antithyroid drugs became available. (NRC, 2005) By 1984, another study administered potassium perchlorate to 18 people with hyperthyroidism caused by Graves' disease. (Wenzel and Lente, 1984) The high doses on the order of 900 mg per day were gradually reduced to an average of 93 mg per day. Absence of the antibodies indicated that the patients no longer had Graves' disease. Thus, one could consider treatment in the latter 12 months to be equal to administration of perchlorate to healthy people. Therefore, the results provide evidence that moderately high doses of perchlorate given chronically to people with a history of hyperthyroidism do not cause hypothyroidism. (NRC, 2005) There are no reports of the appearance of new thyroid disorders, thyroid nodules, or thyroid carcinomas in patients treated with potassium perchlorate for hyperthyroidism. (NRC, 2005)

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[3] All EDWC values listed are based on the default adult drinking water consumption of 2.0 liters per day and the default adult body weight of 70 kilograms.
[4] According to the National Graves' Disease Foundation (2000), Graves' disease "represents a basic defect in the immune system, causing production of immunoglobulins (antibodies) which stimulate and attack the thyroid gland, causing growth of the gland and overproduction of thyroid hormone. Similar antibodies may also attack the tissues in the eye muscles and in the pretibial skin (the skin on the front of the lower leg).
[5] Aplastic anemia occurs when the bone marrow stops making enough blood-forming stem cells. (Aplastic Anemia and MDS International Foundation, Inc., 2005)
[6] Agranulocytosis occurs when there are an insufficient number of granulocyte type white blood cells. This can cause an individual to become susceptible to an infection or can be caused when white blood cells are destroyed faster than they can be produced. (Medline Plus, 2005)

Exhibit M-6 briefly summarizes the parameters and results of five more recent studies in which lower doses of perchlorate were given to healthy subjects over various amounts of time to determine the effects on thyroid function. Each study measured the amount percent decline of iodide uptake after varying dosages of perchlorate.

Exhibit M-6. Summary of Perchlorate Studies

Study	Subjects	Dosage and Duration	Results
Study 1 - Brabant et al., 1992	5 Men	200 grams of iodide daily for 28 days followed by 900 mg of perchlorate daily for 28 days	Concentration of TSH, T4, and total thyroid iodide content were slightly lower after administering perchlorate
Study 2 - Lawrence et al., 2000	9 Men	10 mg of perchlorate daily for 14 days	No change in the concentration of T4, T3, or TSH A 42% reduction of iodide uptake in the thyroid
Study 3 - Lawrence et al., 2001	8 Men	3 mg of perchlorate daily for 14 days	No statistically significant change in the rate of iodide uptake
Study 4 - Greer et al., 2002	16 men 16 women	0.02 mg/kg 0.1 mg/kg 0.05 mg/kg for a total of 14 days	For 0.02 mg/kg, a 16.4 percent decrease in the rate of iodide uptake For 0.1 mg/kg, a 44.7 percent decrease in the rate of iodide uptake For 0.5 mg/kg, a 67.1 percent decrease in the rate of iodide uptake
Supplemental Study 1 for Study 4 - Greer et al., 2002	1 man 1 woman	0.02 mg/kg 0.1 mg/kg 0.05 mg/kg for a total of 14 days	For 0.02 mg/kg, a 16.4 percent decrease in the rate of iodide uptake For 0.1 mg/kg, a 44.7 percent decrease in the rate of iodide uptake For 0.5 mg/kg, a 67.1 percent decrease in the rate of iodide uptake
Supplemental Study 2 for Study 4 - Greer et al., 2002	1 man 6 women	0.007 mg/kg daily for a total of 14 days	No change in the concentration of T4, T3, or TSH No change in the rate of iodide uptake in the thyroid

Study	Subjects	Dosage and Duration	Results
Study 5 - Braverman et al., 2005	13 Subjects	Placebo daily for 6 months 0.5 mg of perchlorate daily for 6 months (0.007 mg/kg) 3 mg of perchlorate daily for 6 months (0.04 mg/kg)	No change in the concentration of T4, T3, or TSH No change in the rate of iodide uptake in the thyroid

The results of the studies in which thyroid function was assessed in several ways are remarkably consistent. The study subjects were healthy men and women 18 to 57 years old, and no one was taking medications that might influence thyroid radioiodide independently of perchlorate. In the studies in which thyroid radioiodide uptake was measured, the baseline values varied somewhat among the subjects, but no more than expected in healthy people eating their usual diet. The normal range for 24-hour thyroid uptake of radioiodide in many places in the U.S. is between 10 and 30 percent, also reflecting variation in dietary iodide intake. Although individual study groups were small (4 to 10 subjects), the results were highly consistent within each treatment group in that the variance of the change, or lack of change, in thyroid radioiodide uptake during potassium perchlorate administration was similar to or less than the variance at baseline.

The effects of similar doses of potassium perchlorate on thyroid radioiodide uptake were similar. A daily perchlorate dose of 0.007 mg/kg (EDWC: 245 ppb) had no statistically significant effect in two studies (Greer et al., 2002; Braverman et al., 2005); a daily dose of 0.02 mg/kg (EDWC: 700 ppb) had a small effect (about 15 percent inhibition of thyroid iodide uptake) (Greer et al., 2002); and daily doses of 0.03 and 0.04 mg/kg (EDWCs: 1,050 and 1,400 ppb) had no effect in two other studies. (Lawrence et al., 2000; Braverman et al., 2005)

Perchlorate is still used to diagnose defects in the synthesis of thyroid hormones and as a treatment for patients who have developed hyperthyroidism after being exposed to the antiarrythmic drug amiodarone; however, perchlorate is rarely used to treat any type of hyperthyroidism in the U.S.

M.6.3 Nonthyroid Effects of Perchlorate

Exposure to perchlorate can cause other nonthyroid effects. Most human health effects that stem from perchlorate exposure are related to the disruption of the function of the NIS. The disruption is caused by perchlorate binding with the NIS, thereby inhibiting the NIS from binding with iodide. The NIS is present in the human body in

- Salivary glands;
- Mammary glands, especially during lactation;
- Stomach;
- Choroid plexus of the brain; and
- Ciliary body of the eye (Dohan et al., 2003).

Iodide and NIS functions in these tissues are not the same as in the thyroid. The iodide transported into those tissues is not further metabolized as it is in the thyroid gland. Instead, iodide is rapidly returned into the circulation or secreted into the saliva or breast milk. Iodide transport into these tissues has not been confirmed to be required for their normal function, with the possible exception of mammary tissue. Furthermore, TSH has been found to increase only the NIS content in thyroid tissue. Perchlorate acutely inhibits iodide transport in salivary and mammary tissue, but it does not appear to reduce the iodide content of breast milk. (NRC, 2005)

Very small amounts of the NIS have been detected in other tissues, including the heart, kidneys, lungs, and placenta. Perchlorate is not known to cause congenital malformations, but the relationship has not been well studied.

Some of the side effects of high doses of perchlorate – rashes, aplastic anemia, or agranulocytosis – might have been immunologic responses. Those effects could be caused by a direct toxic effect of perchlorate itself, a contaminant of it, or an immunologic reaction to the drug or a contaminant that is not known. The fact that the effects were dose-dependent argues for direct toxicity rather than an immunologic reaction. Regarding a possible immunologic effect of perchlorate, it is not possible to assess potential clinical effects from experiments in which high doses of perchlorate were added directly to immune cells *in vitro*. In summary, there is no evidence that regular ingestion of perchlorate in any dose causes immunologic abnormalities in humans. (NRC, 2005)

M.6.4 Animal Toxicology Studies

The pituitary-thyroid system of rats is similar to that of humans. For example, decreases in thyroid hormone production result in increased secretion of TSH, which then increases thyroid production and release of T_4 and T_3. However, differences in binding proteins, binding affinities of the proteins for the hormones, turnover rates of the hormones, and thyroid stimulation by placental hormones create important quantitative differences between the two species. Therefore, although studies in rats provide useful qualitative information on potential adverse effects of perchlorate exposure, they are limited in their utility for quantitatively assessing human health risk associated with perchlorate exposure.

There are several controversial issues regarding animal toxicology studies. One is the interpretation of results of rat studies that evaluated the effects of maternal perchlorate exposure on offspring brain development. In those studies, female rats were given ammonium perchlorate throughout pregnancy and into the postnatal period. Linear measurements of several brain regions of the male and female pups at several postnatal ages were compared with control values. Serious questions have been raised regarding the design and methods used in those studies. The NRC report agreed with some previous reviewers that the methodological problems, such as possible systematic differences in the plane of section across treatment groups, and the lack of a consistent dose-response relationship, make it impossible to conclude whether or not perchlorate exposure causes changes in brain structure.

Other studies that have received critical attention are rat studies that investigated the effect of maternal exposure on offspring neurobehavior. In the primary study, female rats were treated with ammonium perchlorate throughout pregnancy and into the postnatal period, and the offspring were evaluated with a battery of behavioral tests. Overall, the NRC report found that the functions evaluated (i.e., activity, auditory startle, learning, and memory) were appropriate but no significant effects of perchlorate were observed in any of the behavioral measures except an increase in motor activity in male pups on one day of testing. Because the tests lacked the sensitivity to detect subtle effects, the NRC report concluded that the data were inadequate to determine whether or not gestational or lactational exposure to perchlorate affects behavioral function in rats.

Concerns have also been raised over the significance of the results of a two-generation rat study in which benign thyroid tumors were observed in two male offspring. Both the parent generation and the offspring were given ammonium perchlorate before mating, during mating, gestation, and lactation, and until sacrifice. The NRC report concluded that the thyroid tumors in the offspring were most likely treatment-related, but that thyroid cancer in humans resulting from perchlorate exposure is unlikely because of the hormonally mediated mode of action and species differences in thyroid function.

High doses of perchlorate in humans with hyperthyroidism have caused side effects that could be considered immunologic responses; however, immunotoxicity studies in mice revealed no changes in immunologic function in response to perchlorate exposure. Therefore, the NRC report found that there is no evidence of a causal relationship between perchlorate ingestion and any biologically meaningful stimulatory or inhibitory effect on the immune system in rodents. The report concludes that the side effects in humans were probably toxic effects of the very high doses of perchlorate given to those patients.

M.6.5 Epidemiologic Studies

Numerous epidemiologic studies have examined the associations of environmental exposure to perchlorate in drinking water at levels between 4 and 120 ppb. These studies addressed abnormalities of thyroid hormone and TSH production in newborns, thyroid diseases (i.e., congenital hypothyroidism, goiter, and thyroid cancer), and cancer in infants and adults. (Lamm and Doemland, 1999; Brechner et al., 2000; Crump et al., 2000; F.X. Li et al., 2000; Z. Li et al., 2000; Schwartz, 2001; Morgan and Cassady, 2002; Kelsh et al., 2003; Lamm, 2003; Buffler et al., 2004)

Occupational studies of respiratory exposures up to 0.5 mg/kg perchlorate per day (EDWC: 17,500 ppb) have been conducted. These studies addressed the abnormalities of thyroid hormone and TSH production in adult workers. (Gibbs et al., 1998; Lamm et al., 1999; Braverman et al., 2005) Only one study has examined a possible relation between perchlorate exposure and adverse neurodevelopmental outcomes in children (e.g., attention-deficit-hyperactivity disorder [ADHD] and autism). (Chang et al., 2003) A number of the studies have samples that are too small to detect differences in the frequency of outcomes between exposure groups.

No studies have examined the relationship of perchlorate exposure to adverse outcomes among especially vulnerable groups, such as low-birth weight or preterm infants. In addition, the available studies do not assess the possibility of adverse outcomes associated with perchlorate exposure in infants born to mothers who had inadequate dietary iodide intake. Thus, no direct human data are available regarding a possible interaction between maternal iodide intake and perchlorate exposure.

Nearly all the studies were ecologic studies (i.e., general population studies), which include newborns and children, who are potentially most vulnerable to the effects of perchlorate exposure. Ecologic studies can provide supporting evidence of a possible association but cannot provide definitive evidence regarding cause. Perchlorate exposure of individuals is difficult to measure and was not assessed directly in any of the studies conducted outside the occupational setting. One study took perchlorate measurements directly from drinking-water samples taken from faucets in Chile. (Crump et al., 2000)

The design of an ecologic study is inherently limited with respect to establishing causality. However, results of ecologic studies can be informative when combined with other data on the biology of the thyroid gland, experimental studies of the effects of acute exposure to perchlorate, and studies of occupational perchlorate exposure.

Acknowledging that ecologic data alone are not sufficient to demonstrate whether or not an association is causal, the NRC report provided evidence bearing on possible associations and reached the following conclusions regarding the proposed association of perchlorate exposure with various health end points:

- Congenital hypothyroidism (deficiency of thyroid hormone production). The available epidemiologic evidence is not consistent with a causal association between perchlorate exposure and congenital hypothyroidism as defined by the authors of the studies reviewed by the NRC report. All studies of that association were negative, meaning that perchlorate exposure was not found to cause congenital hypothyroidism.

- Changes in thyroid function of newborns. The available epidemiologic evidence is not consistent with a causal association between exposure to perchlorate in the drinking water during gestation (up to 120 ppb) and changes in thyroid hormone and TSH production in normal-birth weight, full-term newborns. Most of the studies show neither significantly lower T_4 production nor significantly higher TSH secretion in infants born in geographic areas in which the water supply had measurable perchlorate concentrations. However, no data are available on the association of perchlorate exposure with thyroid dysfunction in the groups of greatest concern, low-birth weight or preterm newborns, offspring of mothers who had iodide deficiency during gestation, or offspring of hypothyroid mothers. There have been no adequate studies of maternal perchlorate exposure and neurodevelopmental outcomes in infants.

- Neurodevelopmental outcomes. The epidemiologic evidence is inadequate to determine whether or not there is a causal association between perchlorate exposure and adverse neurodevelopmental outcomes in children. Only one pertinent study has been conducted, an ecologic study that examined the association of perchlorate exposure with autism and ADHD. Although the NRC report considered the inclusion of ADHD plausible, it questions the appropriateness of autism as an end point given that autism has not been observed in the spectrum of clinical outcomes in children who had congenital hypothyroidism and were evaluated prospectively. (Rovet, 1999, 2002, 2003)

- Hypothyroidism and other thyroid disorders in adults. The evidence from chronic, occupational exposure studies and ecologic investigations in adults is not consistent with a causal association between perchlorate exposure at the doses investigated and hypothyroidism or other thyroid disorders in adults. In occupational studies, perchlorate doses as high as 0.5 mg/kg per day (EDWC: 17,500 ppb) have not been associated with adverse effects on thyroid function in workers. However, the small sample sizes in some studies may have reduced the ability to identify important differences, and the studies were limited to those workers who remained in the workforce.

- Thyroid cancer in adults. The epidemiologic evidence is insufficient to determine whether or not there is a causal association between exposure to perchlorate and thyroid cancer. Only two pertinent ecologic studies have been conducted. In one, the number of cancer cases was too small to have a reasonable chance of detecting an

association if one existed. (Li et al., 2001) In the second (Morgan and Cassady, 2002), subjects were exposed to both perchlorate and trichloroethylene. It was not possible to adjust for potential confounding variables in either study.

M.7 Ecological Impacts

The potential ecological impacts of perchlorate are discussed in this section. The characteristics and behavior of perchlorate in the environment are explained, followed by a discussion of ecotoxicology in aquatic and terrestrial environments.

M.7.1 Chemical Characterization and Fate in the Environment

The perchlorate anion (ClO_4^-) forms weak bonds with cations (positively charged ions) to produce perchlorate salts (e.g., ammonium, lithium, potassium, and sodium perchlorate salts) and weak complexes. These salts and acids are very soluble in water (>200 grams/liter) with densities greater than water. (Mendiratta et al., 1996) Once dissolved, perchlorate is extremely mobile in water systems. Limited published information is available on the fate of perchlorate in the environment. The scientific literature does not contain environmental partitioning coefficients or degradation rates. The perchlorate ion is highly charged; however, there is no evidence that perchlorate is attracted to soil particles. Therefore, it is likely to move through soil as it does in water. Perchlorate in the soil may be re-released into the environment via leaching from irrigation and/or rainfall. Perchlorate is not expected to be in the atmosphere because it has low vapor pressure; thus, it will not volatilize from water systems or the land. Perchlorate particles can be suspended in the air but return to the ground via dry deposition (gravity) or wet deposition (precipitation).

Perchlorate is chemically stable, meaning that it requires a high amount of energy to break it down. Its stability is based on its atomic structure: four oxygen atoms surrounding each chlorine atom. This results in perchlorate’s resistance to degradation and/or biotransformation under most environmental conditions, allowing it to persist for many decades in terrestrial and aquatic systems.

M.7.2 Ecotoxicity

The USAF sponsored studies that evaluated the effects of perchlorate in aquatic systems on primary and secondary production, toxicity to aquatic organisms, decomposition, biodegradation, and bioaccumulation. (USAF, 2002) Terrestrial ecotoxicity is also discussed below.

Aquatic Environment

Studies indicate that the presence of perchlorate has little effect on common processes in the aquatic environment. For example, photosynthesis in aquatic systems was minimally affected by high aquatic perchlorate concentrations. High levels (1,000 ppm) of perchlorate can adversely affect marine phytoplankton or bacterioplankton (secondary production). However, coastal waters are large areas constantly circulating and mixing, and it is unlikely such high concentrations of perchlorate would be encountered except for short periods of time. (USAF, 2002)

Likewise, respiration, as a measure of decomposition in marine and freshwater sediments and wetland peat, was not adversely affected by high perchlorate concentrations. It is unlikely that concentrations exceeding this level would be encountered in sediments except in small regions in direct contact with solid propellant for extended periods of time. Perchlorate concentrations in sediments did not tend to decrease over a seven-day incubation period. Anaerobic bacteria are capable of respiring perchlorate and this process has been observed in perchlorate-contaminated sediments. However, this ability tends to be associated with chronically contaminated systems. (USAF, 2002)

Perchlorate concentrations nearing 30 ppm had no effect on the stickleback, a freshwater to brackish water fish. The study evaluated mating and the birth and growth of young fish. Although morphological or behavioral abnormalities may occur as the young fish matures, these characteristics were not evaluated in this study. (USAF, 2002) Effects measured as growth and mortality, ranged from a No Observed Effects Level (NOEL) of 10 mg/liter in the water flea (*Ceriodaphnia dubia*) to a NOEL of 155 mg/liter in a fresh water fish (*Pimephales promelas*). The Lethal Concentration for 50 percent of the water flea population (LC_{50}) was 66 mg/liter. (U.S. EPA, 2002)

Several studies have evaluated the effect of perchlorate on algae/bacteria and animals in and around an aquatic environment. A USAF study (USAF, 2002) showed that both the microbial and fish components accumulated significant levels of perchlorate. Susarla et al., 2000 also found that perchlorate can accumulate in aquatic vascular plants. Further, both the USAF and Smith et al., 2001 found that perchlorate could be passed on to following trophic levels. The U.S. Army Corps of Engineers study (Condike, 2001) demonstrated that fish tissue concentrations of perchlorate exceed comparable concentrations detected in the water, indicating the bioaccumulation of perchlorate in fish tissue, a conclusion also supported by Smith et al., 2001.

Terrestrial Environment

In the terrestrial environment, perchlorate can influence natural soil processes and can be taken up by plants. For example, in the presence of high levels of perchlorate (between 100 and 1,000 ppm), soil samples exhibited significant decreases in respiration activity

indicating that decomposition of perchlorate, nutrient recycling, and potentially plant growth will slow down. (USAF, 2002)

Phytoremediation studies have found that terrestrial plants will uptake perchlorate, first in the leaves, followed by stems, then roots, and that perchlorate concentrations are usually greater than in surrounding soil samples. (Susarla et al., 2000; Parsons, 2001) However, perchlorate was not detected in terrestrial birds, mammals, or insects when soils were reported to contain 0.3 to 0.4 mg/kg of perchlorate. Perchlorate breakdown products – chlorate, chlorite, and chloride – were detected in plant tissues but were not quantified.

M.8 Guidance and Recommendations

No Federal drinking water standard for perchlorate has been established. Although MDA is not responsible for evaluating the health effects or potential risk of perchlorate exposure, it will adhere to any applicable drinking water standards or regulations promulgated by the U.S. EPA or state authorities. Pending the establishment of a drinking water standard, MDA will continue to mitigate potential introduction of perchlorate into the environment by properly disposing of rocket fuel debris resulting from non-normal detonations/explosions of boosters on the pad.

Section M.8.1 discusses the existing Federal guidance on perchlorate from U.S. EPA and the NRC. Section M.8.2 provides explanations of two of the existing state ground water guidance levels that were developed for Massachusetts and California. Section M.8.3 describes other scientific studies that have made recommendations regarding perchlorate levels.

Many of the studies express their scientific findings in terms of an RfD, which is determined based on body weight and is expressed in mg/kg. An RfD is a reference dose level and in itself is not considered a standard that can be implemented as a regulation. To determine a drinking water standard for perchlorate, a number of ppb allowed in drinking water must be calculated. A drinking water standard is developed based on a number of factors, including the RfD, potential exposure to sensitive populations, and possible exposure to perchlorate from other sources (e.g., food, milk).

For example, a recent study by the Environmental Working Group[7] found perchlorate in 31 of 32 California supermarket milk samples taken from supermarkets in Los Angeles and Orange Counties. The levels of perchlorate measured in these samples ranged from non-detectable levels to 3.6 ppb. (FDA, 2005) In a separate study, the Food and Drug Administration found perchlorate in several samples of milk taken from retail locations

[7] The Environmental Working Group is a nonprofit research organization, which uses “the power of information to educate the public and decision-makers about a wide range of environmental issues, especially those affecting public health.”

around the country. Perchlorate levels in the milk from these retail locations ranged from 3.16 to 11.3 ppb in 101 out of 104 samples, with perchlorate levels that were not quantifiable in three samples. (FDA, 2005) The mean measured perchlorate level for this study was 5.76 ppb for the 104 samples. The Food and Drug Administration also cited a 2003 Texas Tech University that found perchlorate levels ranging from 1.7 to 6.4 ppb in seven fluid milk samples and 1.1 ppb in one evaporated milk sample. (FDA, 2005)

A separate study completed by Texas Tech University also considered perchlorate content in 47 samples of dairy milk and 36 samples of human milk. Perchlorate was detected in 46 of the dairy milk samples and in all of the breast milk samples. (Kirk et al, 2005) The mean perchlorate levels were 2.0 micrograms/liter in dairy milk and 10.5 micrograms/liter in breast milk, with maximum levels of 11 and 92 micrograms/liter, respectively. (Kirk et al., 2005) Although the Texas Tech study relied on a relatively small sample size the researchers found that perchlorate in breast milk is not well correlated with the water the mothers are drinking. The study hypothesizes that perchlorate consumption comes primarily from food rather than water or beverages. (Kirk et al., 2005)

Iodine-deficient vegetarians (especially women of child-bearing age) have been proposed to be a sensitive, perchlorate-susceptible population; however, studies reviewed by Fields, et al. (2005) indicate that vegetarian diets do not necessarily lead to iodine deficiency and that vegans[8] may actually have excess iodine intake. The authors question the necessity of applying the 10-fold default uncertainty factor (UF) for intraspecies (i.e., within human) variability to protect this hypothetical and unlikely subpopulation.

M.8.1 Federal Guidance

This section provides a description of the recommended guidance related to perchlorate as established by U.S. EPA and the NRC. Each organization reviewed and analyzed existing studies to support its recommendation.

U.S. EPA Analysis and Recommendation

U.S. EPA's perchlorate RfD comes from the technical review of the "Health Implications of Perchlorate Ingestion" by the NRC of the NAS (NRC, 2005). Iodide uptake inhibition was determined to be the key biochemical event that precedes all potential thyroid-mediated effects of perchlorate exposure. Because iodide uptake inhibition is not an adverse effect but a biochemical change, this is a NOEL. The use of a NOEL differs from the traditional approach to deriving an RfD, which bases the critical effect on an adverse outcome. Using a no adverse effect that is upstream of the adverse effect is a

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[8] In this instance the term "vegan" applies to someone who is a strict vegetarian; and therefore, consumes no animal food or dairy products.

more conservative and health-protective approach to perchlorate hazard assessment. The resulting official RfD established by U.S. EPA was 0.0007 mg/kg per day of perchlorate. This corresponds to estimated drinking water equivalent level of approximately 24.5 ppb.[9] This level is not a Federal drinking water standard but is consistent with the recommended RfD included in the NRC January 2005 report. (U.S. EPA, 2005b)

The National Academy of Science, National Research Council Analysis and Recommendation

The NRC report on perchlorate exposure and human health, entitled *Health Implications of Perchlorate Ingestion*, emphasized that its RfD recommendation differs from the traditional approach to deriving the RfD in that it recommended using a no adverse effect rather than an adverse one. (NRC, 2005) The report reviewed the human and animal data and found that the human data provided a more reliable point of departure (POD) for the risk assessment than the animal data. The NRC report recommends using clinical data collected in a controlled setting with the relevant routes of exposure to derive the RfD.

The NRC report also did not recommend using the available epidemiologic studies to derive the POD for the risk assessment based on limitations of ecological studies discussed in Section 5.5. Instead, the NRC report recommended using the Greer et al. (2002) study in which groups of healthy men and women were administered perchlorate at 0.007 to 0.5 mg/kg per day (EDWC: 245 to 17,500 ppb) for 14 days. That study identified a NOEL for inhibition of iodide uptake by the thyroid at 0.007 mg/kg per day (EDWC: 245 ppb). The NRC report concluded that the NOEL value from Greer et al. (2002) is a health-protective and conservative POD and is supported by the results of a six-month study of 0.007 mg/kg per day (EDWC: 245 ppb) in a small group of healthy subjects, a four-week study of higher doses in healthy subjects, the studies of perchlorate treatment of patients with hyperthyroidism, and extensive human and animal data that demonstrate that there will be no progression to adverse effects if no inhibition of iodide uptake occurs.

The report's recommendations would lead to an RfD of 0.0007 mg/kg per day. This corresponds to estimated drinking water concentration of approximately 24.5 ppb. That value is supported by other clinical studies, occupational and environmental epidemiologic studies, and studies of long-term perchlorate administration to patients with hyperthyroidism. The report concluded that an RfD of 0.0007 mg/kg per day should protect the health of even the most sensitive populations. The NRC report acknowledges that the RfD may need to be adjusted upward or downward on the basis of future research.

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[9] A drinking water equivalent level is a conversion of the reference dose to a drinking water concentration taking body weight and water consumption into consideration.

Department of Defense

MDA will follow the perchlorate guidance developed by the DoD that establishes 24 ppb as the current level of concern for managing perchlorate found on DoD sites. The level of concern is based on the RfD established by the NRC study, which was subsequently adopted by the EPA. Where sampling indicates perchlorate concentrations above the level of concern, DoD Components are directed to conduct site-specific risk assessments. If a risk assessment indicates perchlorate concentrations could potentially result in adverse health effects, the site will be prioritized for appropriate risk management. In addition, DoD Components will: (1) assess for off-range migration of perchlorate from operational ranges; (2) test quarterly for perchlorate at DoD-owned drinking water systems until they are satisfied that concentrations are likely to remain below the level of concern; and (3) sample semi-annually at permitted point sources where the use of perchlorate is associated with processes related to the manufacture, maintenance, processing, recycling or demilitarization of military munitions. (DoD, 2006) Sampling results will continue to be maintained in the perchlorate database developed pursuant to the September 29, 2003, "Interim Policy on Perchlorate Sampling," which this policy statement supersedes. (DoD, 2003)

M.8.2 State Guidance

Exhibit M-7 shows state advisory levels for perchlorate that were established as of April 2005.

Exhibit M-7. State Perchlorate Advisory Levels (as of April 20, 2005)

State	Advisory Level	Supplemental Information
Arizona	14 ppb	1998 health based guidelines for child exposures
California	6 ppb	Public health goal – California expects to propose a maximum contaminant level in 2005
Maryland	1 ppb	Advisory level
Massachusetts	1 ppb	Advisory level for children and at risk populations – Massachusetts proposed a maximum contaminant level of 1 ppb and started the evaluation process
Nevada	18 ppb	Public notice standard
New Mexico	1 ppb	Drinking water screening level
New York	5 ppb	Drinking water planning level
	18 ppb	Public notification level
Texas	17 ppb	Residential protective cleanup level
	51 ppb	Industrial/commercial protective cleanup level

Source: U.S. EPA, 2005c

The remainder of this section describes the RfD and guidance levels implemented by the states of Massachusetts and California, and how their decisions were arrived at based on existing scientific research.

Massachusetts Department of Environmental Protection

To establish an RfD for perchlorate, the Massachusetts Department of Environmental Protection applied standard U.S. EPA UFs to the lowest observed adverse effect levels (LOAELs) for animals and humans. (U.S. EPA, 2002a and b; Massachusetts Department of Environmental Protection, 2004) Several sets of UFs were identified and applied to the animal and human LOAELs to arrive at a number of RfDs that span a range of possible true values. The RfD value at the higher end of this range is only 1.3 times the value in the lower end of the range. Since the Massachusetts Department of Environmental Protection as a rule develops a single RfD and not a range, the value of 0.00003 mg/kg per day (EDWC: 1 ppb) was selected as the point estimate for the RfD.

California Environmental Protection Agency

The California Environmental Protection Agency's (California EPA) Public Health Goal is based on the same human clinical study used in the analysis for NASA as described in Section 8.3 below. (Greer et al., 2002; California EPA, 2004) Rather than focusing on T_4 levels, California EPA selected iodide uptake inhibition as the critical effect. Using benchmark dose modeling, a 5 percent decrease in 24-hour iodide uptake ($BMDL_{05}$) was estimated to occur at a dose of 0.0037 mg/kg per day (EDWC: 130 ppb). After the application of UFs and exposure duration, the resulting RfD is 0.00037 mg/kg per day. Using a tap water consumption rate and body weight ratio of 25.2 kg/day per liter for the 95th percentile value of the pregnant woman population and a relative source contribution of 60 percent, the estimated drinking water concentration of 6 ppb of perchlorate was determined.

On August 11, 2005 the California Developmental and Reproductive Toxicant Identification committee, an independent scientific panel, decided against adding perchlorate to the Proposition 65 list of chemicals known to the state of California to cause birth defects or other reproductive harm. The committee can only list a substance if it has been "clearly shown" to cause reproductive toxicity. A decision that a substance falls short of the "clearly shown" standard does not mean that the committee believes that the substance is non-toxic. (California Office of Environmental Health Hazard Assessment, 2005)

M.8.3 Other Recommendations

This section describes three other studies that resulted in the recommendation of a drinking water advisory level for perchlorate. These recommendations are not Federal

drinking water standards but add to the general scientific knowledge base regarding perchlorate.

Dollarhide Analysis and Recommendation

As in the California EPA (2004) analysis, the RfD determined by Dollarhide was based on the Greer et al. (2002 study with iodide uptake inhibition as the critical effect. (Dollarhide et al., 2002) However, the benchmark response (an adverse effect, used to define a benchmark dose from which an RfD can be developed) was set at 20 percent inhibition ($BMDL_{20}$) rather than 5 percent inhibition. Therefore, the POD for derivation of the RfD was a $BMDL_{20}$ of 0.02 mg/kg per day. After consideration of UFs and exposure duration, the resulting RfD is 0.002 mg/kg per day. This corresponds to an average drinking water concentration of approximately 65 ppb.

Strawson Analysis and Recommendation

In this analysis, the RfD is based on an epidemiological study of elementary school children (ages 6 to 8) in three regions of Chile with varying degrees of perchlorate contamination. (Crump et al., 2000; Strawson et al., 2003) The drinking water exposure levels were estimated to be 0; 4 to 7; or 100 ppb. There were no effects on T_4 levels in any of the populations following exposure throughout their life (including *in utero*). Therefore, the POD for derivation of the RfD was a free-standing No Observed Adverse Effect Level (NOAEL) of 0.006 mg/kg per day (estimated daily dose based on drinking water concentration). After consideration of UFs and exposure duration, the resulting RfD is 0.002 mg/kg per day. This corresponds to an average drinking water concentration of approximately 65 ppb. A major limitation of the Crump et al. (2000) study is that Chilean children have much higher iodine intake (10-fold) than U.S. children of the same age. Therefore, this study cannot be expected to accurately predict levels of perchlorate exposure associated with adverse effects in populations with normal iodine intake.

Crump and Gibbs Analysis

Crump and Gibbs (2005) performed benchmark calculations for perchlorate using human data from three previous perchlorate studies - Lamm et al. (1999), Greer et al. (2002), and Braverman et al. (2005). They determined that the statistical lower bound on the benchmark dose was between 0.36 - 0.92 mg/kg per day for serum thyroid hormone and 0.21 - 0.56 mg/kg per day for free T4 index. These benchmark dose level values required to cause hypothyroidism in adults would be in agreement with the value of 0.4 mg/kg per day that was obtained by the NRC report (2005).

Exhibit M-8 below provides a summary of the guidance and recommendations discussed in Section M.8. This exhibit shows the citation, a description, and the critical endpoints

of the scientific study from which the agencies or organizations based their recommendation. The exhibit also provides a side-by-side comparison of the POD, UFs, and RfD values.

Exhibit M-8. Comparison of Health Criteria Values for Perchlorate Derived by Different Agencies/Groups

	U.S. EPA (2002b)	NRC (2005)[13]	MA Department of Environmental Protection (2004)	California EPA (2004)	TERA (Dollarhide et al., 2002)	TERA (Strawson et al., 2003)
Critical Study	Argus (1998, 2001)	Greer et al. (2002)	Greer et al. (2002); Argus Laboratories (2001)	Greer et al. (2002)	Greer et al. (2002)	Crump et al. (2000a)
Type of Study	Sprague-Dawley rats, neurohistological/ neurodevlopmental toxicity	Human adult volunteers, controlled, clinical, 14 days	Human adult volunteers, controlled, clinical, 14 days; Sprague-Dawley rats, neurohistological/ neurodevelopmental toxicity	Human adult volunteers, controlled, clinical, 14 days	Human adult volunteers, controlled, clinical, 14 days	Human children (6 to 8 years of age) volunteers in Chile, population-based cross-sectional
Critical Study Endpoint(s)	Changes in brain morphometry in pups on post-natal day (PND) 21 and decreasedT_4/increased TSH in dams of effected pups at various pre- & post-natal time intervals	Inhibition of radioiodide uptake by the thyroid	Radioiodide Uptake Inhibition; Brain Morphometry Changes (corpus callosum, striatum, cerebellum)	5 percent decrease in 24-hour iodide uptake after 14 days exposure	20 percent decrease in 24-hour iodide uptake after 14 days exposure	Change in T_4 levels following lifetime exposure, including during gestation
POD (mg/kg per day)	LOAEL = 0.01	NOEL = 0.007	NOAEL = 0.007 LOAEL = 0.01	$BMDL_{05}$ = 0.0037	$BMDL_{20}$ = 0.02	NOAEL = 0.006 (free-standing)
UFs [1]	$UF_H = 3$ $UF_{DUR} = 3$ $UF_L = 10$ $UF_{DB} = 3$	$UF_H = 10$	$UF_H = 10$ $UF_L = 3$ $UF_A = 10$	$UF_H = 10$ $UF_{DUR} = 1$	$UF_H = 10$ $UF_{DUR} = 1$	$UF_H = 3$ $UF_{DUR} = 1$
RfD (mg/kg-day)	0.00003	0.0007	0.000085 – 0.00007 0.00003	0.00037	0.002	0.002

[1] UFs: UF_A = animal to human extrapolation; UF_H = intra-individually in humans; UF_{DUR} = exposure duration; UF_{DB} = database deficiencies; UF_L =LOAEL to NOAEL extrapolation
TERA -Toxicology Excellence for Risk Assessment

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[13] A study by Crump and Greer found benchmark dose level values required to cause hypothyroidism in adults would be in agreement with the value of 0.4 mg/kg per day that was obtained by the NRC report (2005)

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APPENDIX N
IMPACTS OF RADAR ON WILDLIFE

IMPACTS OF RADAR ON WILDLIFE

N.1 Introduction

This appendix responds to comments from the USFWS on the Draft BMDS PEIS by providing an analysis of the impacts from radar on wildlife. Specifically, this appendix provides

- Background information including electromagnetic radiation (EMR) wavelengths of concern, radar operations, and characteristics unique to BMDS radars;
- Analysis of biological effects including absorption of EMR, basis for the 1999 Institute of Electrical and Electronics Engineers (IEEE) Standard to Protect Humans from EMR Exposure, thresholds for effects in birds, and studies of effects of EMR on migrating birds;
- Exposure assessment considering bird migration, radar operation, and estimates of duration and magnitude of exposure; and
- Impact characterization including individual and population risks, uncertainties, and mitigation measures.

Concerns raised by the USFWS include consideration of

- The potential effects of radar on very large flocks of migrating birds;
- The sufficiency of evidence to support the statement that no significant adverse impacts to birds would occur even if a bird is not within the most intense area of the beam for any considerable length of time;
- An analysis to describe what constitutes a "relatively small" beam size;
- Description of the potential adverse effect to birds from radar operation;
- Discussion of the potential of using Next Generation Weather Radar (NEXRAD) to help evaluate when large flocks may be in the testing area; and
- The fact that arctic foxes, which are very efficient predators, are present in areas where the COBRA DANE radar operates, and would quickly remove evidence of any bird kills.

The USFWS indicated that the 1993 Final Ground-Based Radar Family of Radars EA report used to support statements concerning potential effects of radar on migrating birds was out of date and inadequate for drawing conclusions of no harm. Some of the qualitative statements concerning no harm to birds can be supported by more quantitative data than was presented in the 1993 report. To do this it was necessary to first review the analyses provided in Appendix A of the 1993 report (Section N.2 of this appendix), and then describe additional quantitative analyses conducted to estimate the probability of harm to populations of migrating birds for this PEIS (Sections N.3 through N.7 of this appendix).

N.2 Review of 1993 EA Analysis of Potential Effects on Migrating Birds

As stated in the Draft BMDS PEIS, the 1993 Final Ground-Based Radar Family of Radars EA analyzed potential impacts on wildlife from EMR on migrating birds that might fly through the path of the radar beams. That analysis concluded that because the main beam would normally be in motion, it would be extremely unlikely that a bird would remain within the most intense area of the beam for any considerable length of time. That analysis also noted that the size of the beam is "relatively small," further reducing the probability of birds remaining within this limited region of space, even if the beam remained stationary. (U.S. Army Space and Missile Defense Command, 2003) The quantitative analyses supporting that conclusion were presented in part in Appendix A of the 1993 EA. (U.S. Army Space and Strategic Defense Command, 1993) The key points of this analysis are presented below.

To estimate a radar power density that might represent a lower threshold for adverse effects in birds based on heating from EMR at frequencies of 8 to 12 gigahertz (GHz), the analysis used data from rats indicating behavioral changes occurring at energy absorption rates of 4 watts per kilogram body weight (W/kg bw) over relatively long periods of time. The American National Standards Institute (ANSI) used the rat exposure studies and a safety factor of 0.1 applied to the 4 W/kg level to derive a maximum exposure level. Considerations such as the relative body size and EMR penetration depth in biological tissues at 10 GHz were used to establish the ANSI 1982 C95.1 limit for continuous human exposure to 10 GHz EMR expressed as a power density of 5 milliwatts per square centimeter (mW/cm^2). That value assumes the polarization of the EM field is aligned with the long axis of the body; other orientations would result in lower EM power absorption rates. In 1991, the IEEE revised that standard based on additional considerations to 10 mW/cm^2 averaged over six minutes, with a peak electric field (E) not to exceed 100,000 volts per meter (V/m) for controlled populations (i.e., occupational exposures). For uncontrolled populations (i.e., the public), the maximum exposures were set to 5.3 to 8 mW/cm^2 for frequencies from 8 to 12 GHz (with averaging times ranging from 11.3 to 7.5 minutes).

To estimate risks to migrating birds from XBR beams, the 1993 EA evaluated the potential for the radar beams to cause heating of bird tissues. Because the metabolic rate associated with sustained flight generally is 7 to 10 times resting metabolic rate, and for peak flight bursts might be as high as 20 times resting metabolic rate, the analysts assumed that birds should be able to tolerate an additional thermal load equivalent to 1 times their basal metabolic rate. The analysts therefore estimated a specific absorption rate (SAR) for birds that, if averaged over the entire body of the bird, would be equivalent to the resting metabolic rate.

Metabolic rates of birds vary with body weight; empirically derived allometric models are available to relate metabolic rate to body weight for different groups of birds (e.g., passerines, seabirds). In general, passerines have higher resting metabolic rates than other groups of birds. (Lasiewski and Dawson 1967) The 1993 EA Appendix A does not specify which allometric equations were used. The analysts noted further that there will be variation in absorption of EM for a given radar beam power density at a given frequency (and wavelength) as a function of bird size. They calculated that for birds weighing between 25 grams (g) and 3.5 kilograms (kg), i.e., from warbler to eagle or goose-sized birds, EMR power densities that would deliver an energy input equivalent to the resting metabolic rate would range from between 38 and 61 mW/cm^2. For the Aplomado falcon (*Falco femoralis*) in particular, the analysis indicated that the power density would have to exceed 42 mW/cm^2 to cause thermal loading equal to 1 times the metabolic rate of the bird.

Finally, based on a volumetric analysis of the proportion of airspace over a radar that would include the radar beam at power densities exceeding 38 to 61 mW/cm^2 averaged over a six-minute interval, analysts concluded that birds in flight had a less than one percent risk of incurring harm from a beam in motion. Specifically, analysts estimated that 0.014 to 0.025 percent (i.e., 1/4,000 to 1/7,000) of the airspace surrounding a radar might contain the beam at any given time. Details of the volumetric calculations were not provided. Note that a six-minute averaging time is likely to be very much longer than is relevant for a bird passing through a moving radar beam. Thus, the EMR power densities of 38 to 61 mW/cm^2, estimated to be thresholds for thermal loading effects in birds, are more conservative than necessary for shorter duration exposures, as discussed below.

N.3 Overview of Appendix

The assessment in this appendix of potential impacts of BMDS radars on migrating birds, particularly during testing phases, focuses on potential duration and magnitude of exposure of birds encountering beams, as well as the likelihood that birds might encounter the beams. This analysis includes review of the most recent basis for the IEEE standards for human exposure to EMR to determine if the bases for those standards have changed. As part of this analysis, reference hazard values were developed for migrating birds that are somewhat more conservative than the ones developed for birds of different sizes for the 1993 EA. Due to the sensitive nature of specifications of individual radars in the BMDS program, radars have been analyzed by category. In some cases, the most powerful radar in operation in each category is well known, with many published sources describing it. Where there is the potential of risk of impact to some birds, the specific radar type and the conditions under which a risk to migrating birds might exist is identified. For instances where a potential risk exists, mitigation measures are provided.

N.4 Background on Radar Systems

The BMDS program includes a large number of different types of radar systems for surveillance, detection, and tracking of missiles. These radar systems are described in Appendix E of this PEIS. Because there are many types of radar systems, it is necessary to provide background on the relationship between EMR frequency and potential for absorption of EMR by animals of different sizes. This discussion is provided in Section N.4.1. Section N.4.2 of this Appendix provides an overview of several types of calculations relevant to estimating radar EMR at varying distances from the source. Section N.4.3 evaluates the potential effects of the proposed BMDS radars on migrating birds.

N.4.1 EMR Wavelengths of Concern

EMR consists of inter-related E and magnetic (H) fields that oscillate at the sending frequency and travel at the speed of light. EMR frequency (f) and wavelength (λ) are related according to the equation:

Equation 1

$$\boldsymbol{\lambda = c/f}$$

where

λ	= wavelength in meters (m)
c	= speed of light (3×10^8 m/second)
f	= frequency in Hertz (Hz; cycles/second)

To facilitate later discussion, Exhibit N-1 shows the relationship between EMR frequency in megahertz (MHz) and wavelength in meters for selected frequencies between 10 MHz and 12,000 MHz.

Exhibit N-1. EMR Penetration Depth in Muscle Tissues vs. Frequency/Wavelength

Frequency (MHz)	Band	Wavelength (meters)	Penetration depth in muscle (cm)	Biological entity of similar size
10	HF	30		
30	VHF	10		
70	VHF	4.3		human
100	VHF	3	6.2	human
300	VHF/UHF	1	3.3	goose
435	UHF	0.69		eagle
650	UHF	0.46		bobwhite, rat
915	UHF	0.33		plover, robin
1,000	UHF/L	0.30	2.5	catbird
2,000	L/S	0.15	2.0	swallow, mouse
2,450	S	0.12		goose or eagle head
3,000	S	0.10	1.7	warbler
4,000	S/C	0.075		
5,000	C	0.06	1.0	
7,500	C	0.04		robin head
8,000	C/X	0.0375		
10,000	X	0.03	0.4	warbler head
11,000	X	0.0273		
12,000	X	0.025		

MHz = megahertz; HF = high frequency, VHF = very high frequency, UHF = ultrahigh frequency; L = long; S = short; C = compromise between X and S bands.
Source for penetration depth: AFRL 2005, Figure 2.

EMR is reflected or absorbed by different materials and objects to varying degrees depending on several parameters, including the material surface characteristics, its conductivity/impedance, the size and shape of the object relative to the wavelength of the incident EMR field, and orientation of the object relative to the incident field. Absorption of EMR is maximal when the long-axis of the object (e.g., animal body) is oriented in the direction of the electric field vector, i.e. the incident plane wave is perpendicular to the body. When wavelengths are much shorter than the length of an animal body, EMR is absorbed in the skin surface facing the source. For wavelengths approximating twice the length of the body, the body itself acts as an antenna to enhance the coupling of the EMR energy into the body.

Dosimetry studies for humans have demonstrated that maximum energy transfer occurs when the height of an individual approximates four-tenths the length of the EMR

wavelength. The frequency of maximal absorption is called the resonance frequency, and for humans, it is between 70 and 100 MHz.

The depth to which radar EMR can penetrate biological materials generally decreases with increasing frequency and depends on the impedance of the material. Measured penetration depths for muscle tissue are included for some frequencies in Exhibit N-1; penetration depths for fat are higher (see Figure 2 in AFRL 2005). Thus, the higher the EMR frequency, the more shallow the penetration and the lower the potential for warming effects in an animal, with XBR penetrating only a fraction of a centimeter into muscle tissues.

Exhibit N-1 includes the corresponding wavelengths in meters for comparison with birds of different sizes (considering the length of the body from head to base of tail). For reference, Exhibit N-1 also shows the human and laboratory rat and mouse. Because it is possible for the head (or other body parts) of an animal to have its own resonance and absorption characteristics, estimates of the size of the head of a few types of birds is included as well. From Exhibit N-1, it is clear that the EMR frequencies of most concern for migrating birds range from 300 to 10,000 MHz (wavelengths from about 100 to 3 cm, respectively). EMR with shorter or longer wavelengths is outside of the principal resonant frequencies for migrating birds.

N.4.2 Radar Basics

Radar is an acronym for **RA**dio **D**etection and **R**anging. The radar frequencies are organized by bands: UHF band (300 MHz to 1 GHz), L-band (1 to 2 GHz), S-band (2 to 4 GHz), C-band (4 to 8 GHz), and X-band (8 to 12 GHz).

The power in a radar beam at some distance from the source depends on the power at the source, radar power efficiency, antenna gain, and distance from the source. It is often expressed as a power density (S) in units of watts per unit area. For radar performance calculations, power density is expressed in watts per square meter, and for biological effects, in mW/cm^2. Due to spherical spread, S decreases with the square of the reciprocal of the distance from the radar.

Radar antenna radiation fields are divided into near field and far field regions. Within the far field region, the angular EMR power density distribution is essentially independent of the distance from the radar and the E and H field vectors form a plane-wave. Within the near field region, the angular EMR power density distribution is a function of range. In the far field, the power density S is calculated as follows:

Equation 2

$$\mathbf{S} = (\mathbf{P} / 4\,\pi\,\mathbf{r}^2) \cdot \mathbf{G}_T$$

where

S is the power density in watts per unit square meter
P is the radiated peak power
r is the range in meters
$\mathbf{G}_T$ is the transmitter antenna gain in a particular direction

The antenna gain (G_T) describes the degree to which the radar is able to concentrate its power in a given direction and is highest along the main axis of the radar beam. The gain in Equation 2 is expressed as the ratio of the maximum radiation intensity of the actual antenna in a given direction over the radiation intensity of an isotropic antenna (i.e., radiating energy in all directions uniformly) with the same power input, and is dimensionless.

For plane waves, the power density (S) is related to electric field strength (E) and magnetic field strength (H) by the impedance of free space, i.e., 377 Ohms (Ω), as in Equation 3.

Equation 3

$$\begin{aligned}\mathbf{S} &= E^2/377 \\ &= 377 \cdot H^2\end{aligned}$$

where

S is in units of watts per square meter
E is in units of volts per meter
H is in units of amperes per meter

Equation 4 is used where S in units of mW/cm^2 is desired.

Equation 4

$$\begin{aligned}\mathbf{S} &= E^2/ (377 \cdot 10) \\ &= 377 \cdot 10 \cdot H^2\end{aligned}$$

where S is in units of milliwatts per square meter, and E and H are as in Equation 3.

The start of the far field region, given by Equation 5, is where the antenna gain versus angular direction is independent of range for both the mainlobe and sidelobes of the antenna pattern. However, a well formed mainlobe can appear at ranges less than the range computed by Equation 5. In the near field, the power density estimated using Equation 2 overestimates the power density to some extent, particularly for phased-array radars.

Equation 5

$$\text{Far Field Range (m)} = \frac{2 \cdot (\text{antenna diameter (m)})^2}{\text{wavelength (m)}}$$

At distances less than those calculated using Equation 5, Equation 2 overestimates the power densities by an increasing amount as the distance to the antenna decreases. A generalized equation for calculating power density in the near field does not exist. Radar-specific models must be used to accurately estimate near field power densities.

N.4.3 Radars in the BMDS Program

The BMDS program radars operate within five different wavebands: UHF, L, S, C, and X bands. To streamline the evaluation of potential impacts to migrating birds, radars were evaluated based on the frequency that corresponds with the birds that might be maximally affected due to the resonant frequencies as indicated in Exhibit N-1.

For each of the five bands, the most powerful type of radar operating in that band was evaluated. Exhibit N-2 provides unclassified specifications on source power (both peak and average), beam width, antenna diameter, wavelength, and antenna gain for the most powerful radar in each band. The representative radar from each band is Position and Velocity Extraction Phased Array Warning System (PAVE PAWS) for UHF, COBRA DANE for L-band, Aegis for S-band, MPS-36 for C-band, and Sea-Based X-Band Radar (SBX) for X-band.

Exhibit N-2. Unclassified Specifications for Radars Used by MDA

Radar Antenna Type	Frequency	Peak Power (kW)	Average Power (kW)	-3 dB Beam Width (deg)	Antenna Diameter (m)	Wave-length (cm)	Gain (dB)
		Upper Bound (all values approximate)					
Phased Array	X-band (8 to 12 GHz)	500 [a]	150 [a]	0.2 [a]	9 [a]	2.5 - 3.75	53.2
Dish	C-band (4 to 8 GHz)	2,500 [b]	6 [c]	0.4 [c]	10 [c]	4 - 8	51.7
Phased Array	S-band (2 to 4 GHz)	2,200 [a]	65 [a]	2.0 [a]	5 [a]	7.5 - 15	38.6
Phased Array	L-band (1.22 – 1.25 GHz)	15,500 [c]	1,000 [c]	0.7 [a]	30 [c]	23 - 25	49.5
Phased Array	UHF (420-450 MHz)	582 [d]	146 [d]	2.2 [d]	22 [d]	67 - 71	38.0

[a] Technical Realities: An Analysis of the 2004 Deployment of a U.S. National Missile Defense System, Union of Concerned Scientists, May 2004
[b] Range Instrumentation Handbook, Vandenberg Air Force Base, September 2000
[c] GMD Validation of Operational Concept, MDA, April 2002
[d] NMD Deployment Final EIS, Ballistic Missile Defense Organization, July 2000. Peak and average power as reported by MITRE (2000) are 543 and 136 kW, respectively.

The peak power is actually the root mean square (RMS) power over a single pulse period, while the average power is the power averaged over a longer interval of time, such as one second. Because the radar emissions are pulsed, with off periods during which the radar “listens” for the returning reflected beams, average power is always less than peak power. The longer the listening intervals compared with the radar emission, the lower the average power relative to peak power. Phased array radars can have duty cycles as high as 25 percent. The maximum antenna gain can be approximated by assuming a circular aperture and computing the gain from Equation 6 using the given antenna diameter, D.

Equation 6

$$\mathbf{G}_T = 4\,\pi\,(\pi\,D^2 / 4)/\lambda^2$$

N.5 Biological Effects

This section first discusses EMR dosimetry expressed as the SAR. It then discusses the derivation of current IEEE exposure limits recommended for humans and notes their applicability to migrating birds. This section concludes by examining studies of potential effects of tracking radars on migrating birds for evidence that lower levels of EMR could interfere with their orientation.

N.5.1 Absorption of EMR

SAR has been used to express EMR dosimetry for many years. SAR expresses the rate at which EMR energy is absorbed from the incident field in units of watts per kilogram of body weight. It is a function of a variety of parameters of the body, including size relative to the incident wavelength, shape, density, total mass, and orientation relative to the incident field (SAR is higher when the body is more perpendicular than parallel to an incident field). As noted in Section N.4.1 above, SAR is highest at resonant frequencies. For example, for an adult male human exposed to an incident power density of 10 W/m^2 (1 mW/cm^2), the average SAR will be highest at an exposure of 0.25 W/kg at a frequency near 70 MHz. For a rat exposed to that power density at that frequency, the average SAR would be only 0.0125 W/kg. The average SAR for rats is highest at frequencies near 700 MHz, where exposure to an incident power density of 10 W/m^2 (1 mW/cm^2) would result in an average SAR of 0.8 W/kg. For humans exposed to that power density at 700 MHz, the SAR is less than 0.04 W/kg.

SAR for different species of birds will be maximal at the resonant frequencies for their body size (or size of the head). Exhibit N-1 indicates which frequencies will be resonant frequencies for different types and sizes of birds.

N.5.2 Basis for IEEE Standard to Protect Humans from EMR Exposure

Table 1 in IEEE Standard C95.1, 1999 Edition (IEEE, 1999) presents the MPE limits for humans in occupational settings (i.e., controlled environments) for frequencies between 0.003 and 300,000 MHz, a revision and expansion of the IEEE Standard C95.1-1991. In the near field region, the MPE is best expressed as either the electric field strength (E) or the magnetic field strength (H). The plane-wave equivalent power density values also are presented for comparison. The MPEs for the IEEE Standard vary with frequency and are most stringent (lowest) in a range of frequencies (30 to 300 MHz) surrounding the resonant frequencies for humans, where the MPE is approximately 1 mW/cm^2 averaged over a six-minute period. The MPE is less stringent at both lower and higher frequencies (e.g., at frequencies between 3,000 and 300,000 MHz, the six-minute average MPE is 10 mW/cm^2).

These MPEs are consistent with the 1991 adopted SAR criterion of 4 W/kg, which was based on behavioral changes observed in laboratory rats due to thermal loading and an

applied safety factor of 10. The working SAR of 0.4 W/kg was reexamined by the Risk Assessment Working Group of the IEEE Standards Committee on Non-Ionizing Radiation Hazards in a comprehensive evaluation of the recent literature and found to be adequate for the 1999 Standard: "An extensive review of the literature revealed once again that the most sensitive measures of potentially harmful biological effects were based on the disruption of ongoing behavior associated with an increase of body temperature". (pg 22; IEEE, 1999) The Committee noted further that "The disruption of a highly demanding operant task is a statistically reliable endpoint that is associated with whole-body SARs in a narrow range between 3.2 and 8.4 W/kg, despite considerable differences in carrier frequency (400 MHz to 5.8 GHz), species (rodents to rhesus monkeys), and exposure parameters (near- and far field, multipath and planewave, CW- and pulse-modulated)." (pg 22; IEEE, 1999) The time-averaged power densities associated with those thresholds ranged from 8 to 140 mW/cm^2.

For exposures to pulsed EMR in the range of 0.1 to 300,000 MHz, the peak (temporal) value of the IEEE MPE in terms of the E field is 100 kV/m. (pg 8; IEEE, 1999) Using Equation 4, that translates into a peak power density (S) of 2,652,520 mW/cm^2.

$$
\begin{aligned}
\textbf{Peak S}\ (\mathrm{mW/cm^2}) &= E^2/3{,}770\ \Omega, \\
&= 100{,}000^2\ (\mathrm{V^2/m^2})/3{,}770\ \Omega \\
&= 2{,}652{,}520\ \mathrm{mW/cm^2}
\end{aligned}
$$

For exposures to pulsed EMR with pulse durations less than 100 milliseconds in the same frequency, the peak power density for a single pulse is given by the MPE (from Exhibit N-1, the E-field equivalent power density) multiplied by the averaging time in seconds and divided by 5 times the pulse width in seconds. (pg 8; IEEE, 1999)

Equation 7

$$\textbf{Peak MPE} = \text{MPE} \cdot \text{Averaging Time (sec)}/5 \cdot \text{Pulse width (sec)}$$

This limit provides a conservative MPE given some uncertainty associated with the value of the spatial peak SAR in short pulses of EMR, which might be as high as 20 times the spatially averaged SAR. Thus, where pulses are less than 100 milliseconds (0.1 sec) in duration, the MPE is reduced by a factor of five. (pg 28; IEEE, 1999) For example, assuming a six-minute MPE of 10 mW/cm^2 for an X-band frequency, the peak MPE allowed for a 100-millisecond pulsed EMR field would be calculated as:

$$
\begin{aligned}
\textbf{Peak MPE} &= 10\ \mathrm{mW/cm^2} \cdot 360{,}000\ \text{milliseconds}/(5 \cdot 100\ \text{milliseconds}) \\
&= 7{,}200\ \mathrm{mW/cm^2}
\end{aligned}
$$

For a 1-millisecond pulse, the corresponding peak MPE would be 720,000 mW/cm^2.

At frequencies below 100 kHz, other biological mechanisms become important (e.g., electro-stimulation of excitable cells), but those frequencies are well below those used for radars. To prevent burns from the higher frequency (including infrared) EMR at frequencies above 15,000 MHz (15 GHz), the averaging time for the exposure duration in the MPE is reduced from six minutes according to Equation 8.

Equation 8

$$\text{Averaging time for the MPE (in minutes)} = 616{,}000 / \text{frequency (in MHz)}^{1.2}$$

The highest frequency proposed for BMDS radars is in the X-band, or under 12,000 MHz. Thus, neither of these frequency extremes needs to be considered for migrating birds potentially exposed to BMDS radars beams.

N.5.3 Threshold for Effects in Birds

Given the wide range of animals and conditions used to establish the human exposure limits for EMR, it is safe to assume that the MPEs for humans are conservatively protective against thermally induced behavioral changes in birds. However, for this analysis those MPEs were modified in two ways. First, the lowest six-minute average MPE value of 1 mW/cm^2 set for the resonant frequencies for humans was applied to the higher resonant frequencies (shorter wavelengths) for birds (Exhibit N-1). Second, the safety factor of 10 was removed to extrapolate from rodents to humans for two reasons. The first reason is that the base SAR threshold of 4 W/kg is conservative in several ways.

- The endpoint for the threshold, behavioral disruption owing to increasing body temperature, will have no permanent physiological effects.
- The SAR threshold assumes the far field, E-polarized "worst case" exposure as the reference condition (the SAR decreases markedly for other polarizations).
- The SAR falls off markedly for frequencies different from resonance.

The second reason it was assumed that the safety factor of 10 does not need to be applied to the SAR of 4 W/kg is that birds have a greater ability to eliminate body heat through respiration (flow-through design) than do mammals, and migrants regularly incur and must dissipate excess metabolic heat during long-distance flights. For the pulsed EMR, the requirement to divide the appropriate time-averaged MPE by a factor of 5 was removed to account for spatial variation of pulsed EMR because of the smaller size of birds relative to humans.

Thus, without conducting a specific evaluation for birds, these considerations indicate that 10 mW/cm^2 averaged over six minutes (or higher power densities averaged over correspondingly shorter periods of time) is a conservative reference value to protect against possible behavioral effects during migration due to thermal heating. This is

consistent with, but slightly more conservative than, the value of 42 mW/cm^2 estimated as a threshold for thermal loading equivalent to 1 times the basal metabolic rate in the Aplomado falcon, and a range of power density thresholds for the same effect from 38 to 61 mW/cm^2 for birds ranging in size from warblers to birds up to 7.7 pounds in weight used in the 1993 EA.

N.5.4 Studies of Potential Effects of Tracking Radars on Orientation and Flight of Migrating Birds

For migratory birds, there is one additional behavioral effect of concern that is not relevant to mammals, which is the possibility that EMR from radars might interfere with navigation during migration for birds that use magnetic cues for orientation. Because many species of birds can use the static magnetic field of the Earth as one of their sensory cues for navigation, it is reasonable to consider whether the EM fields – oscillating, pulsed, or continuous – produced by radar beams might interfere with bird navigation. This concern is relevant to lower power densities than might be associated with actual thermal effects in birds.

Interest in possible reactions of migrating birds to radar beams dates back to the 1940s. Several investigators reported finding short-term deviations in the flight path of migratory birds in the vicinity of radar transmitters based on observations rather than experiments. (e.g., Poor, 1946; Drost, 1949; Knorr, 1954; Hild 1971) Others (e.g., Busnel et al., 1956) were unable to repeat some of these observations. Older laboratory experiments failed to demonstrate reactions of birds to the transmission of continuous waves (e.g., Kramer, 1951, at 52 MHz), but more recent laboratory tests have indicated that at least some avian species can detect pulsed radar signals. For example, Kreithen and Davis (1995) demonstrated physiological reactions of pigeons to pulsed signals in the range of 1.25 to 2.45 GHz, which corresponds to L- to S-band frequencies. More recent field studies have failed to demonstrate changes in bird orientation or migratory behavior in response to radar beams. (Bruderer et al. 1999)

An experimental field study by Bruderer et al. (1999) found no effect of former military radar on the orientation of migrating birds. This XBR of approximately 9 GHz, 100 to 150 kW peak pulse power, 60 to 100 W mean transmitted power, 0.3 millisecond pulse duration, 2,082 Hz pulse repetition frequency, and a 2.2 degree opening angle of the pencil beam, was used to track nocturnal migrants between sunrise and sunset. Bruderer et al. (1999) calculated that a pulse of 100 kW peak power for that radar produces a peak power density of approximately 400 W/m^2 (40 mW/cm^2) at a distance of 250 m from the source and 100 and 25 W/m^2 (10 and 2.5 mW/cm^2) at distances of 500 and 1,000 m from the source, respectively. In these experiments, the radar was used to track the birds for at least 60 seconds with three separate 20-second tracking periods (turned off and on to test for directional responses by the birds) at distances from the radar as close as 200 to 300 m. With one possible exception, the investigators were unable to detect changes in flight

path that might be due to the tracking radar beam. They found that for large migrating birds (e.g., raptors, herons, ducks) reactions were sometimes detected when the radar was aimed at them on approach at a short distance (i.e., 50 to 200 m), but in these cases, the birds may have been able to see the movement in the radar antenna. In contrast, when they used a bright light beam, the majority of birds shifted direction away from the light source and slowed in flight speed at distances up to 1 kilometer from the light source. The only obvious response to the tracking radar was observed in September 1974, when a flock of 21 grey herons (*Ardea cinerea*) flew at an altitude of approximately 1,000 m above the radar in a V formation. When the radar beam was aimed at the flock, the V-formation disintegrated, and the birds flew in horizontal circles for some time before gaining altitude and reforming the V at 1,300 m. This study, in essence, has identified an NOEL for an XBR tracking birds for 20 sec intervals for up to 60 sec at peak power densities up to 40 mW/cm^2. Thus, there is no evidence that the proposed six-minute threshold of 10 mW/cm^2 estimated in this assessment or the six-minute threshold of 42 mW/cm^2 estimated for the falcon in the 1993 EA, would be insufficient to protect against possible effects on birds' magnetic orientation during migration. Data are lacking, however, to evaluate possible effects for birds tracked by radar for between 60 sec and 6 minutes.

N.6 Exposure Assessment

Exposure of migrating birds to radar beams will depend both on the behavior of the birds and the motion and output of the radars. This section includes a brief overview of bird migration patterns, emphasizing altitude, flight speeds, and density of migrating birds. Attributes of the PAVE PAWS radar are provided to illustrate principles of the operation of phased-array radars. Available unclassified radar specification data were then used to estimate maximal exposure durations for birds flying through a BMDS radar beam in each of the five radar categories in Exhibit N-2. This section concludes with estimates of the maximum power densities that might be encountered by birds under both relatively clear weather conditions and poor weather conditions, when the birds may be forced to migrate at lower altitudes than usual.

N.6.1 Background Information on Migrating Birds

N.6.1.1 Migration Flyways

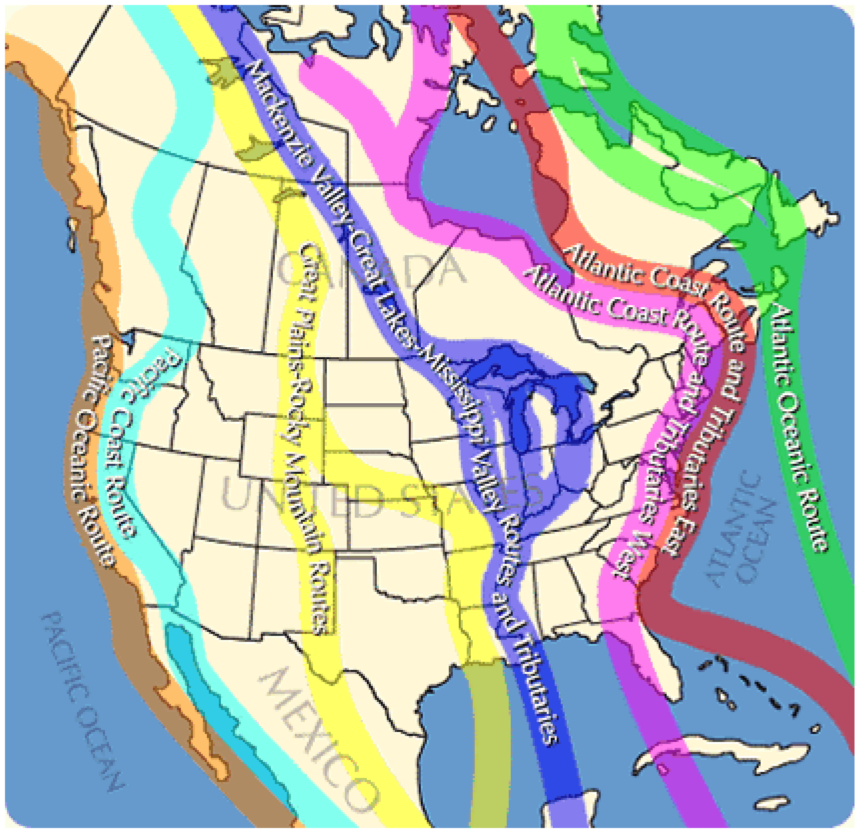
Bird migration generally refers to the movement of birds as they travel to and from their breeding and wintering grounds. The geographic paths that these birds travel are commonly known as migration routes. The migratory movements of most concern are the longer distance flights between North, Central and South America, and between Alaska and Asia, particularly by neotropical songbirds and some species of shorebirds, which have been experiencing population declines over the past several decades. The physiological strain of long-distance migration makes these birds particularly vulnerable to adverse events (e.g., storms) along the route.

Migration routes cover the entire North American continent and no two species follow exactly the same path. Migration routes tend to concentrate along coastlines, major river valleys, and mountain ranges. These broad, heavily traveled corridors comprised of many individual routes are called migration flyways. The concept of a flyway does not imply that all species migrate along definite paths or that all individuals within a species travel along the same route. Rather, flyways are a convenient generalization to help convey the idea that certain factors (e.g., geography, availability of food, etc.) guide the migration of birds along relatively regular paths. (Lincoln et. al., 1998)

Most bird species can navigate during migration using more than one type of cue depending on availability. Cues used by birds to navigate include visual cues (e.g., landmarks, polarization of light, location of setting sun, stars), sound (e.g., ocean waves on coastlines, other sources of infrasound), and 18 species of birds have been demonstrated to have a magnetic "compass" that is recalibrated periodically using other cues. (Wiltschko and Wiltschko, 1996; Hagstrum, 2000; Mouristen and Larsen, 2002; Cochran et al., 2004)

Migration flyways can be broken down into seven generalized routes for birds migrating in the fall from the U.S. to wintering grounds in the West Indies, Central America, and South America. Exhibit N-3 shows the principal migration routes from North America to wintering grounds. The same flyways are generally followed during spring migration, although many species return north over a different route than they used during fall migration. (Lincoln et. al., 1998) Exhibit N-4 describes the general characteristics of the major migration flyways in the U.S.

Exhibit N-3. Principal Migration Routes in North America



Source: Lincoln et. al., 1998

Exhibit N-4. Description of Migration Flyways

Route Name	General Characteristics
Atlantic Ocean	The Atlantic Ocean route passes over the Atlantic Ocean from northeastern Canada to mainland South America, with a stopover on the Lesser Antilles islands. This primarily oceanic route is used by shorebirds and seabirds, such as plovers, auks, and petrels.
Atlantic Coast	The Atlantic Coast route follows the Atlantic coast southward, passing over Florida, various Caribbean islands, and finally ending in South America. It is used by both land and sea birds. The western Atlantic Coast Route is a more direct coastal path to South America but involves much longer flights, and is used primarily by land birds.
Mississippi Valley	The Mississippi Valley route represents the longest migration route in the Western Hemisphere. It begins at the mouth of the Mackenzie River in Canada's Northwest Territories, passes over the Mississippi delta and across the Gulf of Mexico, and eventually ends in Argentina. The

Route Name	General Characteristics
	Mississippi Valley route is the preferred route for the majority of migratory bird species that pass through the U.S.
Great Plains-Rocky Mountains	The Great Plains-Rocky Mountains route also originates in the Mackenzie River delta and passes south through Alberta to western Montana. At this point, some birds move west to the Columbia River valley and then south to California. Other birds travel southeast across Wyoming or Colorado and then merge with Mississippi Valley route. Cranes, geese, pintails, and wigeons are the species most commonly found on the Great Plains-Rocky Mountain Routes.
Pacific Coast	The Pacific Coast Routes are the least heavily traveled migration paths in North America, beginning in western Alaska and continuing over the Gulf of Alaska to British Columbia. They then follow the coastline south, swing inland, and finally end in western Mexico. These routes are used primarily by geese, ducks, and arctic-breeding shorebirds.

Source: Lincoln et. al., 1998

N.6.1.2 Timing of Migration

Birds generally travel during two peak migratory seasons, fall and spring. Fall migration begins around late August and lasts until about early December. Spring migration generally occurs from March to May. (Birdnature.com, 2001)

During migration, some birds fly exclusively at night. The majority of nocturnal migrants are songbirds and other small birds. Radar observations have shown that nocturnal migration begins about an hour after sundown, reaches a maximum shortly before midnight, and then gradually declines until daybreak. (Lincoln et. al., 1998)
The day migrants include larger birds like ducks, geese, loons, cranes, gulls, pelicans, and hawks, and other smaller birds such as swallows and swifts. Soaring birds such as hawks, storks, and vultures can only migrate during the day because they depend on updrafts created either by thermal convection or the deflection of wind by topographic features like hills and mountain ridges. Birds that are able to feed at all hours, such as most water birds, migrate either by day or night. (Lincoln et. al., 1998)

N.6.1.3 Migration Altitude, Speed, and Flock Size

The altitude of migration is extremely variable and depends on factors such as species, location, geography, season, time of day, and weather. Nevertheless, some general conclusions about migration altitude can be drawn based on radar observations of migrating birds. Approximately 95 percent of birds migrate at altitudes under 10,000 ft. (Lincoln et al., 1998) According to the Clemson University Radar Ornithology Laboratory and the USFWS, the vast majority of birds migrate at altitudes between 500

and 4,500 ft, with the highest density of birds found at approximately 1,500 ft. (CUROL, 2005; Lincoln et. al., 1998)

Birds on long-distance flights fly at higher altitudes than short-distance migrants. Some shorebirds have been known travel at 15,000 to 20,000 ft over the ocean. Nocturnal migrants also fly slightly higher than diurnal migrants, but their altitude depends on the time of night. Birds generally gain maximum altitude shortly after sundown and maintain this peak until around midnight. Nocturnal migrants then gradually descend until daylight. (Lincoln et. al., 1998)

In general, migratory birds travel at air speeds of 20 to 50 miles per hour, with ducks and geese flying at 40 to 50 miles per hour, herons and hawks at speeds of 22 to 28 miles per hour, and flycatchers and smaller birds flying at 10 to 17 miles per hour. (Lincoln et al., 1998) In general, the northward spring flights are more direct and slightly faster than the southerly migrations in late summer and early fall.

A majority of bird species migrate in flocks numbering in the hundreds to hundreds of thousands. In general, many species breed over relatively large areas, but during migration, the population can be funneled through a more narrow area. For example, the eastern kingbirds summer breeding range extends 2,800 miles from Newfoundland to British Columbia; however, the width of the migratory path narrows to 400 miles from east-west at the latitude of the Yucatan. (Lincoln et al., 1998)

Several studies of bird migrations using NEXRAD (weather radar) have allowed researchers to estimate the density of migrating birds. (CUROL, 2005) Estimates of 120 to 230 birds per cubic kilometer (km^3) have been recorded for birds flying across the Gulf of Mexico in the spring. Densities of 230 to 490 birds per km^3 have been recorded over the Great Plains in the spring and fall. Densities as high as 500 birds per km^3 have been recorded over Houston, Texas. (CUROL, 2005) Dr. Sidney Gauthreau, the nation's leading expert on bird migration patterns using NEXRAD studies, indicated that the highest recorded density of migrating birds observed is approximately 2,000/km^3. This observation was made one evening during the first week of October above Clemson University in South Carolina after a cold front had passed through the area. (Gaurthreau, 2005) Similarly high densities, however, can be reached when flocks are initially taking off from a dense roosting site.

N.6.1.4 Migratory Bird Stopover Sites

Stopover sites are habitats or natural communities that consistently provide migrants with the necessary resources to refuel and rest during their journey. (NJAS, 2004) The following habitats typically provide the best resources and are therefore the most popular stopover sites for migrants.

Mountain Ridges

The forests along the slopes of mountain ridges typically provide important food resources like insects and fruit. (NJAS, 2004) Higher elevation sites along the slopes or tops of ridges are especially important in the fall, when insect populations peak. (Deinlein, 2005)

Riparian Areas

Major rivers typically support extensive wetlands and woodlands. The vegetation in these riparian areas provides concentrated food sources and sheltered resting areas for migrants. (NJAS, 2004) In the fall, foothill riparian areas provide important fruiting plants for birds such as tanagers and grosbeaks. (Deinlein, 2005) Throughout much of the arid western U.S., riparian forests are oases that offer the only trees to the landscape, and birds rely heavily on them for shelter. (Sterling, 2005)

Barrier Islands and Coastal Marshes

For many migrants, coastal woodlands and barrier islands represent the first opportunity to refuel after a long journey across a large body of water. For this reason, the northern Gulf coast contains many key stopover sites and hosts large numbers of migratory birds during the spring migration. (Deinlein, 2005)

Other key stopover sites, especially for shorebirds, are as follows: the Copper River Delta in southern Alaska; Gray's Harbor in Washington; the Bay of Fundy in Nova Scotia and New Brunswick; the Cheyenne Bottoms in Kansas; the Delaware Bayshore of New Jersey and Delaware; and the prairie pothole region of the northern U.S. and southern Canada. (Deinlein, 2005)

N.6.2 Operation of the PAVE PAWS Phased Array Radar

This section discusses the operation of one of the phased array radars that operates in the UHF frequency, the PAVE PAWS radar, as an example of the operation of radar used both to detect and track incoming missiles. There are three PAVE PAWS radars in the U.S. (Cape Cod, northern California, and Alaska). The PAVE PAWS radar operates at frequencies between 420 and 450 MHz.

Each PAVE PAWS radar is a two-faced phased array radar. Exhibit N-5 depicts the geometry for a single face of the PAVE PAWS radar. The PAVE PAWS phased array aperture is tilted backwards by twenty degrees with respect to the vertical. The array is able to scan a region 60 degrees on either side of the antenna center. Thus a single face of the PAVE PAWS radar can scan a range of 120 degrees (the azimuth).

Exhibit N-6 shows both faces of the PAVE PAWS radar that provides a total coverage of 240 degrees in azimuth. The orientation of the apertures in azimuth is site dependent. Exhibit N-7 shows the actual azimuth directions for each of the PAVE PAWS radars. The Clear, Alaska radar coverage is centered on North, while that of the Beale radar is West, and the Cape Cod radar is oriented East.

Exhibit N-5. Geometrical Orientation of PAVE PAWS Array Face

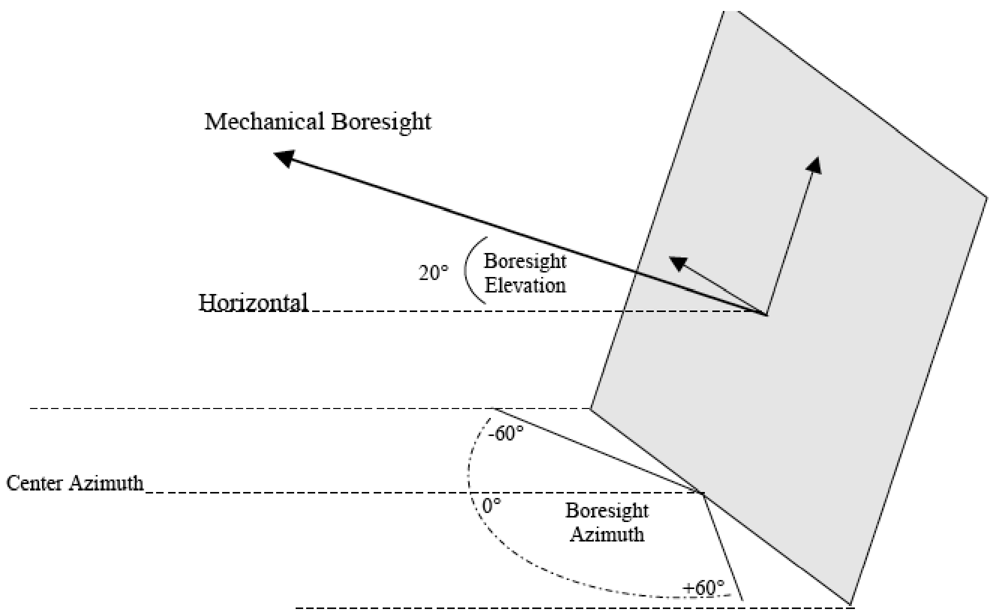


Exhibit N-6. Azimuth Spatial Coverage of PAVE PAWS Two Array Faces

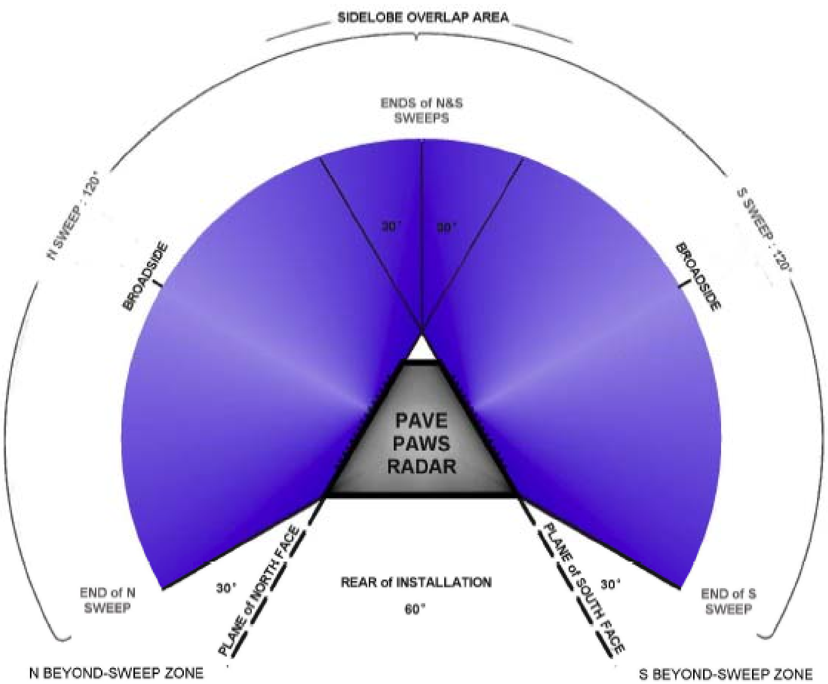
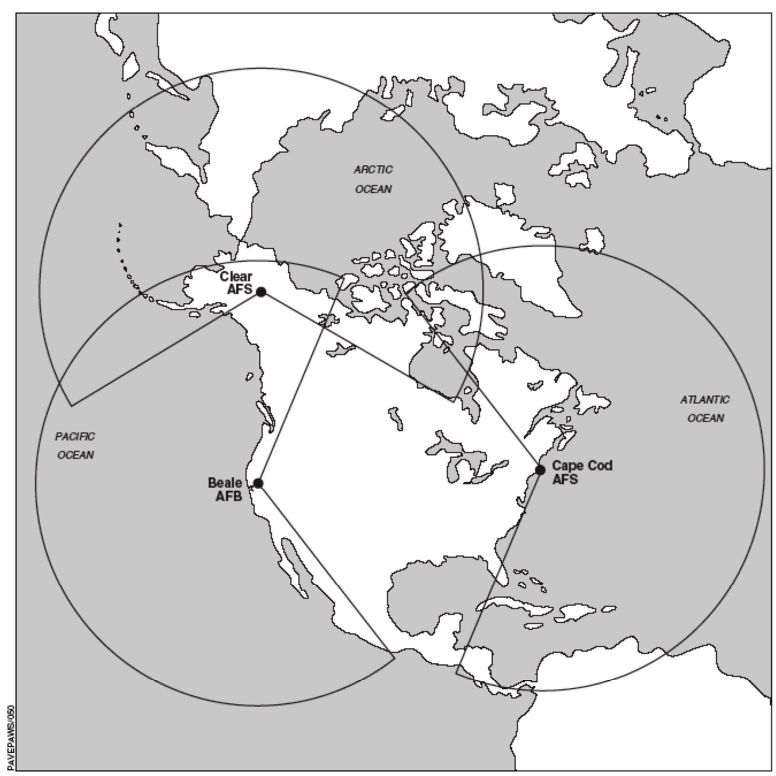


Exhibit N-7. PAVE PAWS Coverage Zones



The PAVE PAWS radar has a maximum duty cycle of 25 percent with the surveillance function occupying 44 percent of the available transmit time. The tracking function occupies the remaining transmit time. The surveillance area for each radar face covers an elevation angle of three to ten degrees above horizontal and an azimuth angle of ± 120 degrees. The array face is tilted 20 degrees back from vertical so that each array scans from -17 to -10 degrees in elevation, with respect to the radar face, to provide the required elevation coverage.

In the far field, the main radar beam is more focused and narrow.[1] For the PAVE PAWS radar, approximately 60 percent of the energy is directed within an angle of 2.2 degrees (-3 dB beam width) (Ballistic Missile Defense Organization [BMDO], 2000), and approximately 90 percent of the energy is directed within an angle of 5 degrees (the -6 dB beam width; Figure 3 in MITRE, 2000). The remaining 10 percent of the energy is located in "sidelobes" where the transmitted waves do not completely cancel each other out. The maximum power density of the sidelobes is typically between 1/100 and 1/1000 of the main beam power density. (MITRE, 2000)

The scanning action of each radar beam occurs rapidly; the beam is redirected in azimuth and elevation on the order of tens of microseconds (μsec) to milliseconds. A pulse duration of 0.3 to 16 milliseconds is used, and the beam is off ("dwells") for approximately 10 to 50 milliseconds "listening for echoes." The beam is then redirected to another azimuth and elevation according to a predetermined schedule. Thus, the maximum duration of the radar beam in any one location is 16 milliseconds (0.016 sec).

The "instantaneous" beam intensity profile of the far field in terms of power density (in mW/cm^2) depends on the radar peak power, the antenna gain, and the distance from the radar. The maximum antenna gain at the center of the main beam in this case is 38.4 dB.

The width of the radar main beam depends on distance from the radar array and orientation of the main beam relative to the direction perpendicular to the antenna arrays. When the radar transmits a beam perpendicular to the radar array, it is said to be "looking at broadside," and when it is in this direction the radar beam is most tightly focused. As the beam is scanned up or down, left or right, from the broadside orientation, the beam widens.

The peak power of the PAVE PAWS radar is 582 kW, which the radar transmits at every energy pulse independent of the pulse width or the waveform. (MITRE, 2000) The average power varies depending on the transmitted pulse width and the length of the

---

[1] The distances to the beginning of the far field is calculated using Equation 5. With the diameter of the active antenna array equal to 22.1 m in this case and the wavelength equal to 0.69 m at center frequency, the nominal far field zone begins at 1,416 m (4,645 ft) for this radar. The distance to the far field reported in MITRE , 2000 was 2,322 ft and by Global Security (http://www.globalsecurity.org/space/systems/pavepaws.htm) is 1,440 ft.

listening period (during surveillance activities). The average power is the peak power multiplied by the fraction of the time that the transmitter is "on."

To determine the "worst case" long-time average power, it was assumed that the radar is operating at its maximum duty cycle (i.e., 25 percent of the duty cycle the transmitter is on, 75 percent of the time it is off, in the "listening" mode). All waveforms have the same peak power (in this case 582 kW). Thus, the maximum average power would be $582 \cdot 0.25 = 146$ kW. A worst-case average power density at the 1,000-ft fence of 0.012 W/cm^2 (12 mW/cm^2) was calculated based on the near field antenna patterns and an elevation of three degrees above horizontal, such that only EMR from the side lobes would reach a human standing on the ground at the fence line. (MITRE, 2000)

The average power density at 460 meters also was calculated in the main direction of the beam using the far field equation (Equation 2). An average source power of 146 kW equals 81.6 dB. Adding the antenna gain of 38.4 dB, the effective radiated power would be 120 dB, or 1,000,000 kW. Using Equation 2, at 460 m, the power density of the main beam would equal 33 mW/cm^2. Note that the far field actually begins at a further distance from the radar in this case. Thus, the value 33 mW/cm^2 somewhat overestimates the power density at 460 m.

N.6.3 Estimates of Exposure Duration

During surveillance tasks, the beam of a phased array radar system changes position every 10 to 100 milliseconds to scan the appropriate air space for potential incoming missiles. The actual duration of a single pulse is less than 16 milliseconds. Dish radars, which move the beam mechanically rather than by varying the phase of emissions from an array of radar antenna, move the beam more slowly when scanning. However, during target tracking tasks and during testing of these systems, the radar beam might be aimed in essentially a single direction. Thus, to estimate maximum possible exposure durations that might occur when testing target tracking functions, a stationary beam was assumed through which migrating birds fly. Exposure durations during surveillance tasks generally will be less than 0.02 seconds owing to the movement of the radar beam.

The -6 dB radar beam widths were used to estimate the maximum amount of time that a single migrating bird is likely to remain in a stationary main radar beam at varying distances from the radar. In Exhibit N-2, the width of a radar beam is specified in degrees, where 360 degrees equals a full circle. Thus, the width of the beam increases with increasing distance from the source. The duration of time a bird might spend flying through only the main beam was estimated. The -6 dB beam width contains approximately 90 percent of the energy emitted. The width of a radar beam for birds flying perpendicular to the direction of the beam at distances between 100 and 3,000 meters from the radar antenna was examined. The distance a bird would fly through a radar beam for birds flying parallel to the direction of the beam was also examined.

For birds flying perpendicular to the direction of the beam, the length of an arc in a beam intersecting an imaginary circle centered at the radar antenna is calculated at distance r from the radar antenna in Equation 9.

Equation 9

$$\mathbf{arc}\ (\mathrm{m}) = 2 \cdot \pi \cdot \mathbf{r} \cdot (\mathbf{w}/360)$$

where

r = radius or distance from the source (m)

w = beam width (degrees)

The calculations using Equation 9 are appropriate for the far field. In the near field the width of the beam was estimated using radar-specific models for the SBX (X-band), COBRA DANE (L-band), and PAVE PAWS (UHF) radars. For the C- and S-bands the analysis assumes that the minimum beam width is equal to the diameter of the radar antenna. Thus, as a conservative measure, Equation 9 was only used to estimate beam width when it resulted in wider arcs than the antenna diameter. The estimated beam widths are listed in Exhibit N-8 for each radar type.

The slowest moving migrants would spend the most time in a stationary radar beam; therefore, the time required for a small bird (e.g., warbler) flying at 10 mph (4.5 meters per second) to fly perpendicularly through a stationary beam at various distances from the radar was estimated, as shown in Exhibit N-9. Note that for the maximum beam width evaluated (2.2 degrees), a small bird could fly through the beam in about 47 seconds at a distance of 3,000 meters and in 2 to 15 seconds at a distance of 100 meters from the radar, where the power density of the beam would be much higher. For birds flying 20 to 40 mph, as do many migrant species, the exposure durations of the birds flying perpendicularly through a stationary radar beam would be one half to one quarter of the values listed in Exhibit N-9.

Exhibit N-8. Width of Main Radar Beam at Increasing Distance from the Source for Different Radars

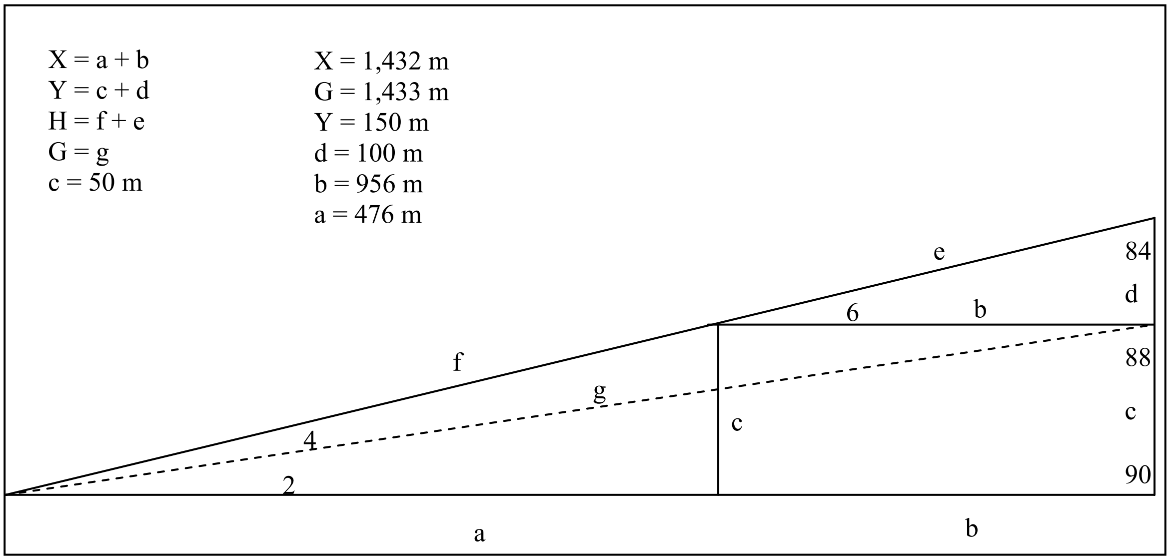
Radar Type	-3 dB Beam width (degrees)	Antenna Width (m)	Width of radar beam (m) with distance from a radar						
			100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	0.2	9	65.9	108.0	117.8	109.4	124.2	115.0	115.4
C-band	0.4	10	10	10	10	10	12.6	20.9	41.9
S-band	2.0	5	7.0	21.0	34.9	48.9	62.9	104.8	209.5
L-band	0.7	30	59.9	57.0	65.9	64.4	62.6	46.0	64.4
UHF	2.2	22	40.4	27.6	36.8	39.9	47.8	71.8	131.5

Exhibit N-9. Maximum Duration of Flight Perpendicular to and Within a Stationary Main Radar Beam at Increasing Distance from the Radar for a Bird Flying 10 mph

Radar Type	-3 dB Beam width (degrees)	Flight duration (seconds) in main radar beam with distance from radar						
		100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	0.2	14.7	24.2	26.4	24.5	27.8	25.7	25.8
C-band	0.4	2.2	2.2	2.2	2.2	2.8	4.7	9.4
S-band	2.0	1.6	4.7	7.8	10.9	14.1	23.4	46.9
L-band	0.7	13.4	12.8	14.7	14.4	14.0	10.3	14.4
UHF	2.2	9.0	6.2	8.2	8.9	10.7	16.1	29.4

For birds flying parallel to the radar beam, the distance the bird must cover to fly through the beam horizontally will be longer than for flight perpendicular to the radar beam. Thus, as the beam moves closer to horizontal, the longer a bird would be in the beam to fly through it horizontally. Exhibit N-10 analyzes a case where a radar that has a -6 dB beam width of 4 degrees is directed with an angular elevation of 4 degrees above horizontal (most proposed BMDS radars do not project less than 3 degrees above horizontal). We further assumed a worst case of the bird flying as low as an altitude of 50 meters above the height of the radar (e.g., as during bad weather), which would result in the bird flying through higher power densities than if the bird were flying at higher altitudes. Because in the far field, power density diminishes with the reciprocal of the square of the distance to the source (see Equation 2), whereas duration of a horizontal flight through the beam increases linearly with the distance from the source at which the bird intersects the beam, the highest risk to the bird will be the closest intersection with the beam, which occurs at the lowest altitude, assumed to be 50 m, relative to the altitude of the radar. In Exhibit N-10, the distance covered by a bird flying through such a radar beam is represented by line segment b. Line segment g (entire dashed line) represents the lower edge of the 4 degree radar beam, which would be 2 degrees above horizontal. Line H (line segments f plus e) represents the upper edge of the 4-degree radar beam, which is elevated 6 degrees above horizontal. Using the relationships depicted in Exhibit N-10, the bird would fly along a distance of 956 m to fly through this beam if it were stationary. A bird flying 4.5 m/sec (10 mph) could traverse 956 m in approximately 214 seconds, or 3.6 minutes. However, the power density associated with this flight would range between the power densities associated with a distance of 478 m (line segment f) to 1,422 m (line G) from the source.

Exhibit N-10. Side View of Radar Beam 4 Degrees in Width Elevated 4 Degrees from Horizontal



Thus, for stationary radar beams, the total time a bird is likely to be in the main beam will be a function of the beam's elevation, the altitude of the bird, and the air speed of the migrating bird. The power densities encountered will depend on the distance from the radar.

For moving radar beams, as during surveillance testing and operations, the maximum duration of an EMR pulse in one direction, and thus the maximum likely exposure duration for a given bird encountering a beam, would be on the order of milliseconds. Of the proposed BMDS radars, the PAVE PAWS has the longest pulse width of up to 16 milliseconds. Pulse widths for PAVE PAWS usually are less than that (as short as 0.3 millisecond), and pulse widths for other radars generally are 1 millisecond or less.

N.6.4 Estimates of Exposure Magnitude

The previous section demonstrated that exposure durations for birds migrating through an area in which BMDS radar is operating in a tracking or calibration mode such that the beam is stationary, are on the order of seconds to tens of seconds, even for the slowest migrants traveling at approximately 4.5 m/sec. Migrating bird exposure durations for radars in surveillance mode are likely to be no longer than 16 milliseconds and usually less than 1 millisecond. The analysis evaluates whether it is possible for some of the radars to be sufficiently powerful to exceed the power density thresholds described in Section N.5.3 for migratory birds flying at low altitudes and slow flying speeds.

The far field equation for calculating EMR power density (S) at a specified distance from a radar source was provided in Section N.4.1 (Equation 2). Because the duration of the

"on" pulse is generally under 0.01 to 0.001 sec and the duty cycle is less than 0.1 sec, it is most appropriate to use the average, not peak, power at the source to calculate average power densities that would apply to exposure durations of longer than 0.1 sec, as would be the case for birds flying through a stationary radar beam.

For birds flying at distances less than the far field from a radar, the power densities are less, and may be substantially less, than calculated using Equation 2. Therefore, near field power densities for the X-, L- and UHF bands were calculated using radar-specific models. For the C and S bands, Equation 2 was used for the near field power density calculations. Equation 5 is used to calculate the beginning of the far field region. For the X-, C-, S-, L- and UHF band radars described in Exhibit N-2, use of Equation 5 and the midpoint of the range of wavelengths listed indicate that the far field region begins at approximately 5,200; 3,300; 440; 7,600; and 1,400 meters, respectively.

Exhibit N-11 presents the power density results in mW/cm^2 for each radar type. In Exhibit N-11, the far field equation (Equation 2) was used to estimate power density, unless radar-specific near field power densities were calculated, which are italicized in Exhibit N-11. Radar-specific near field power densities were calculated because Equation 2 overestimates power densities in the near field. This effect can be observed for the 3,000 meter value for the XBR, which is substantially higher than all of the other X-band values. For the XBR 3,000 meters is still well within the near field region, which ends at 5,200 meters. Note that the reference power density of 10 mW/cm^2 identified in Section N.5.3 for use as a value indicating no impacts on migrating birds is associated with a six-minute averaging period. Higher power densities are allowed for correspondingly shorter periods of time, as will be discussed in Section N.7.

For comparison with the IEEE Standard c95.1-1999 peak power density limit of 2,652 W/cm^2, the peak power output for each radar (i.e., the power during the on phase) was also used to estimate peak power densities at varying distance from each radar type. Exhibit N-12 presents those results. The peak power densities in Exhibit N-12 were calculated using the same methods as in Exhibit N-11. The radar-specific near field power densities are in italics. Thus, Exhibit N-12 is a worst-case estimate of peak power densities with distance from the radar antenna.

Exhibit N-11. Average Power Density at Increasing Distance from the Source for Different Radars

Radar Type	Avg kW	Gain (dB)	Average power density (mW/cm^2) with distance from radar (m)						
			100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	150	53.2	*4.1*	*1.5*	*1.3*	*1.5*	*1.2*	*1.4*	77.3
C-band	6	51.7	699.9	77.8	28.0	14.3	8.6	3.1	0.8
S-band	65	38.6	375.5	41.7	15.0	7.7	4.6	1.7	0.4
L-band	1,000	49.5	*137.4*	*151.9*	*113.5*	*118.9*	*126.0*	*287.4*	*118.8*
UHF	146	38.0	*4.2*	*4.4*	*3.8*	*3.2*	9.1	3.3	0.8

Exhibit N-12. Peak Power Density at Increasing Distance from the Source for Different Types of Radars

Radar Type	Peak kW	Gain (dB)	Peak power density (W/cm^2) with distance from radar (m)						
			100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	500	53.2	*0.02*	*0.01*	*0.01*	*0.01*	*0.00*	*0.01*	0.31
C-band	2,500	51.7	291.6	32.4	11.7	5.9	3.6	1.3	0.32
S-band	2,200	38.6	12.7	1.4	0.51	0.26	0.16	0.06	0.01
L-band	15,500	49.5	*0.55*	*0.61*	*0.45*	*0.48*	*0.50*	*1.15*	*0.48*
UHF	582	38.0	*0.02*	*0.02*	*0.02*	*0.01*	0.04	0.01	0.00

N.7 Impact Characterization and Mitigation

In this section, the exposures estimated in Section N.6 are compared with the reference values for assuming no impact discussed in Section N.5 to characterize potential impacts on a bird that does encounter a radar beam. The potential for population-level impacts are addressed by considering the likelihood that one or more birds in a migrating flock would actually encounter the radar beam. Both subsections N.7.1 and N.7.2 consider the key uncertainties in the estimates used to prepare this appendix and whether those uncertainties will tend to over- or underestimate risks. At the end of this section, recommended mitigation actions are provided for the radars that might, at certain times of the year, at certain locations, and under certain conditions of operation, pose risk to some birds.

N.7.1 Risks to Individual Migrating Birds

This section considers whether the reference values for no harm would be exceeded when a bird encounters a beam. This analysis was performed for each category of radar for a

variety of exposure durations and power densities. Specifically, four evaluations were performed: (1) the potential to exceed the IEEE Standard c95.1-1999 peak power density limit of 2,652 W/cm^2, (2) the potential for the average power density encountered from a stationary radar beam (e.g., tracking or calibration operations) to exceed the reference value of 10 mW/cm^2 averaged over six minutes, after adjusting for duration of exposure, (3), the potential for single 10 milliseconds pulse at peak power to result in an encounter that exceeds a relevant reference value, and (4) the potential for exposures from radars in surveillance mode to exceed the reference value of 10 mW/cm^2 averaged over six minutes.

N.7.1.1 Peak Power Density Limit

The peak power densities in Exhibit N-12 were calculated using the far field equation and radar-specific near field calculations. The peak power density values calculated within the near field using Equation 2 for the C- and S-bands are likely to overestimate the actual power density. Examination of Exhibit N-12 reveals that no birds encountering radar beams would be exposed to EMR that exceeds the IEEE Standard c95.1-1999 peak power density limit of 2,652 W/cm^2.

N.7.1.2 Average Power Density Limits

The reference value for this impact assessment for migrating birds is an average power density of 10 mW/cm^2 associated with a six-minute exposure period. The applicable power density for shorter exposures is higher. For this assessment, both the closest exposures to the highest power densities for birds flying across (perpendicular to) a radar beam and the longest exposures for birds flying along the direction of a near horizontal radar beam were evaluated.

For birds flying perpendicular to the radar beam, the exposure-duration estimates in Exhibit N-9 and the estimates of average power density presented in Exhibit N-11 are used to estimate risk. Exhibit N-13 lists the product of the exposure duration in Exhibit N-9 for a warbler flying 10 mph and the power density in Exhibit N-11 divided by the six-minute averaging time for each of the corresponding cells. The product of exposure duration and power density was divided by six-minutes to normalize the values to allow direct comparison with the 10 mW/cm^2 reference value that is averaged over six minutes. Exhibit N-13 values are in units of mW/cm^2. Where Exhibit N-13 values exceed 10 mW/cm^2, a bird at that distance from that type of radar could be exposed to more EMR than represented by the no-harm reference value.

Exhibit N-13. Average Power Density (mW/cm^2) Multiplied by Exposure Duration Divided by Six Minutes, with Increasing Distance from the Source for Different Types of Radar for Bird Flight Paths Perpendicular to the Radar Beam

Radar Type	Avg kW	Gain (dB)	Power density (mW/cm^2) multiplied by exposure duration (minutes) / six minutes						
			100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	150	53.2	0.2	0.1	0.1	0.1	0.1	0.1	5.5
C-band	6	51.7	4.3	0.5	0.2	0.1	0.1	0.0	0.0
S-band	65	38.6	1.7	0.5	0.3	0.2	0.2	0.1	0.1
L-band	1000	49.5	5.1	5.4	4.6	4.8	4.9	8.2	4.8
UHF	146	38.0	0.1	0.1	0.1	0.1	0.3	0.1	0.1

Exhibit N-13 indicates that there is no concern for slow flying (10 mph) small birds, and thus there is no concern for faster flying larger birds, flying perpendicularly through any of the radar beams. Using the bird-specific six-minute reference values of 38 to 61 mW/cm^2 for birds ranging in size from warblers to 7.7 pounds in weight developed in the 1993 EA, none of the radars would pose a risk to migrating birds.

Note that the values presented in Exhibit N-13 represent a conservative assessment that may overestimate risks. An air speed of 10 mph was assumed for migrating warblers, the slowest of the migrating birds. Exhibit N-13 also assumes that the radar beam is stationary, which is approximately true for phased-array radars only when the radar is tracking targets or during calibration operations. For the dish radars operating in the C-band, mechanical movement of the radar will be slower, but for this radar, even the assumption of a stationary beam does not result in risks of exceeding the no-harm reference value of 10 mW/cm^2 (six-minute average).

Potential risks to birds flying in the direction of stationary beams elevated only 4 degrees above horizontal also was evaluated. For example, for birds flying at an altitude of 50 meters over an S-band radar with a 2.0 degree wide beam (Exhibit N-10), the estimated product of the average power density (between 478 and 1,433 meters; i.e., 9.3 mW/cm^2) and a 214-second exposure divided by six minutes, or 5.5 mW/cm^2, did not exceed our reference value of 10 mW/cm^2. Neither did the combinations of beam width and corresponding exposure duration calculated for altitudes of 50 meters above the X-band, C-band, and UHF radars using the relationships in Exhibit N-10 exceed the no-harm reference value for beam elevations between three and 90 degrees.

For the L-band radar, the reference value, 10 mW/cm^2, was exceeded at flight altitudes of less than 1,700 meters above the radar, when the beam is elevated between four and fifty degrees above horizontal. Exhibit N-14 shows how flight duration, average power

density, and the product of the power density and exposure duration divided by 6 minutes changes with increasing altitude of the bird above the antenna for the L-band radar (COBRA DANE), when the beam is 20 degrees above horizontal, which is when the beam is perpendicular to the radar face and is expected to have the highest power densities. Note that the closest horizontal distance in the right-hand column represents line segment "a" and the farthest horizontal distance represents line "X" in Exhibit N-10. For larger, faster flying birds the exposures would be less. For example, for birds flying 18 meters per second (40 mph) the maximum exposure would be 28 mW/cm^2, except for birds flying at an elevation of 100 meters with a radar beam at three degrees, who would have exposures of 42 mW/cm^2.

Exhibit N-14. L-Band Radar: Average Power Density (mW/cm^2) Multiplied by Exposure Duration Divided by 6 minutes, for Birds Flying Through a Stationary Radar Beam Elevated at 20 Degrees At Varying Altitudes Above the Radar

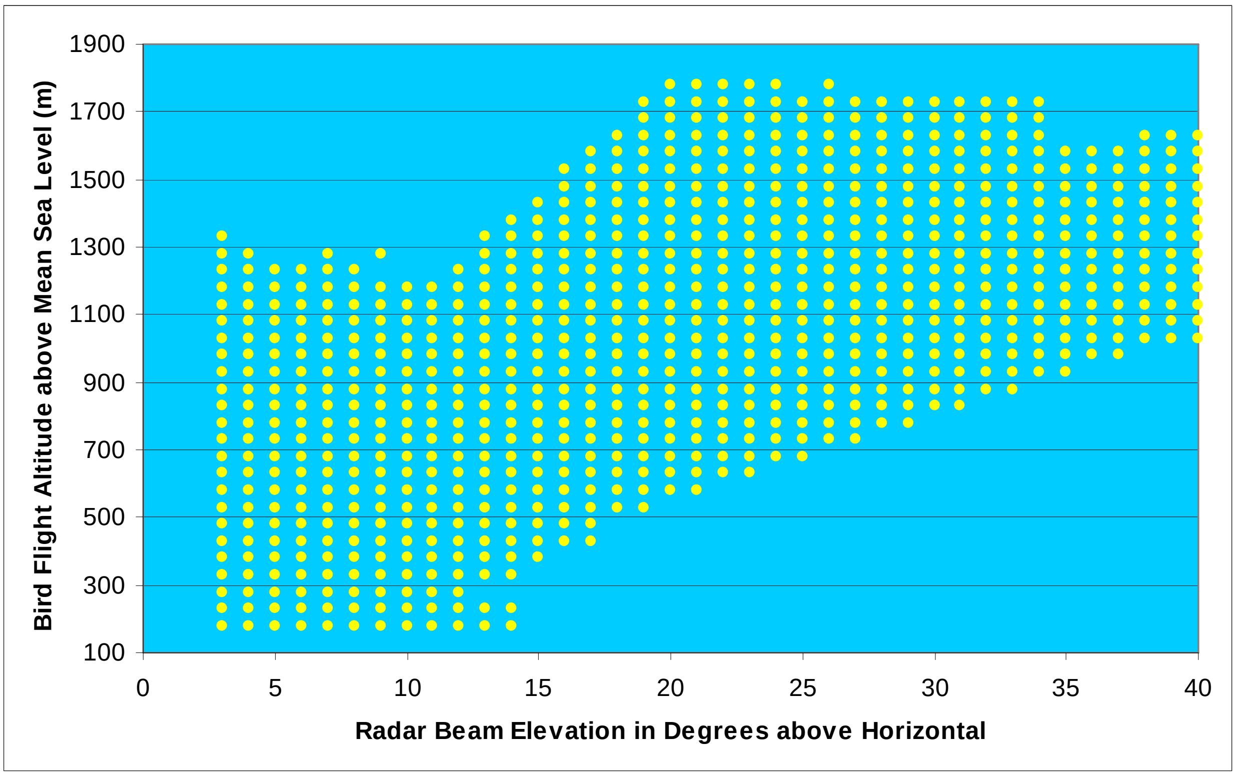
Bird Altitude Above Radar (m)	Flight Duration (T) (sec)	Avg. Power Density (S) (mW/cm^2)	(T · S)/360 sec (mW/cm^2)	Horizontal Distance from Radar (m)
200	20	115.3	6.3	560 - 610
400	20	152.3	8.3	1,130 – 1,210
600	28	278.0	21.7	1,700 – 1,820
800	37	206.3	21.4	2,260 – 2,420
1,000	47	129.2	16.8	2,830 – 3,030
1,200	56	90.1	14.1	3,390 – 3,630
1,400	65	66.3	12.1	3,960 – 4,240
1,600	75	50.1	10.4	4,530 – 4,840
1,700	80	39.5	8.7	4,810 – 5,140

Given the geometry depicted in Exhibit N-10, as the angle of the radar beam increases from 3 to 90 degrees above horizontal, the duration of exposure decreases as a bird begins to fly more perpendicularly to the radar beam. The magnitude of exposure, given by the power density, of the COBRA DANE radar beam changes non-uniformly in the near field as the radar beam moves from an elevation of 3 degrees to 90 degrees. Thus, the analysis shows that for the COBRA DANE radar, a flight altitude of 1,700 meters above the radar would represent a no-harm altitude. This maximum no harm flight altitude occurs when the beam elevation is between about 20 and 40 degrees above horizontal. The COBRA DANE radar face is tilted back 20 degrees from the vertical, thus these elevations represent zero to 20 degrees above the radar bore site.

The COBRA DANE radar is situated near the edge of a cliff 100 meters above sea level and is approximately 30 meters in height. Thus, birds flying at altitudes of less than 1,830 meters above sea level at that location might fly through a stationary beam from the COBRA DANE at levels exceeding the no-harm reference value, 10 mW/cm^2, averaged

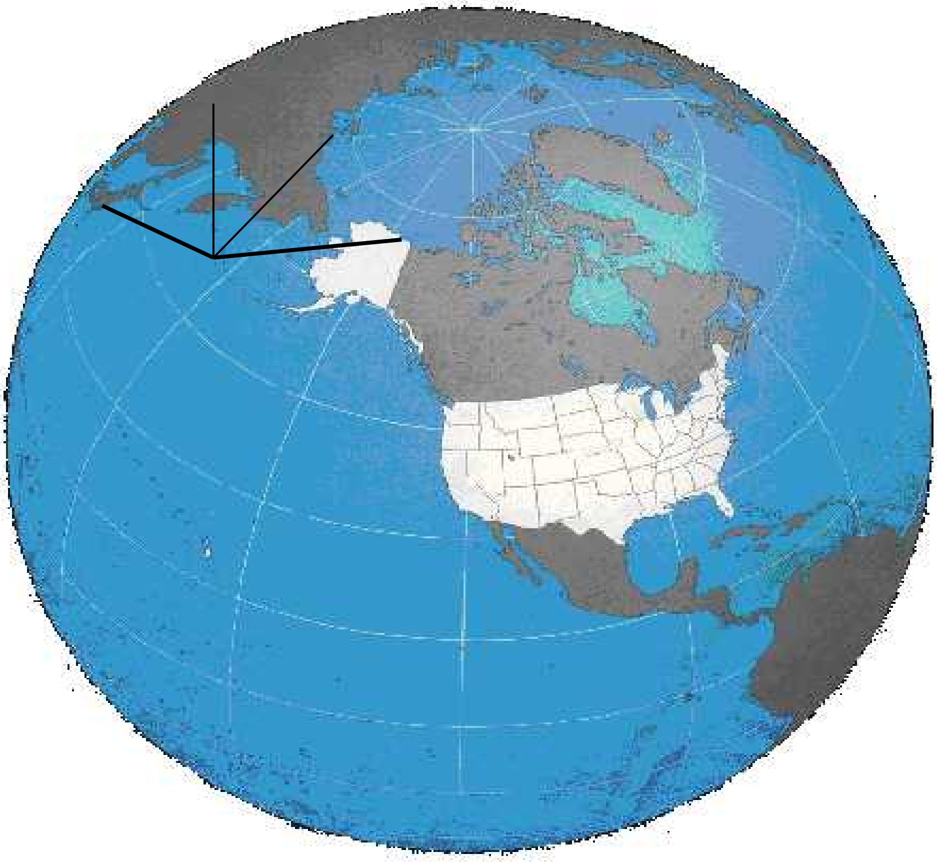
over six minutes. Exhibit N-15 shows the combinations of radar beam elevation and bird flight altitudes that may result in birds receiving exposures above the no-harm reference value of 10 mW/cm^2. Exhibit N-15 also shows that for beam elevations above about 15 degrees and for birds flying at altitudes less than 400 meters, the flight times through the radar beam are sufficiently short that the exposure is less than the no-harm reference value. Thus, at higher beam elevations and for lower flying birds, migrating birds flying parallel to the beam may not receive exposures above the no-harm reference value.

Exhibit N-15. COBRA DANE Radar Beam Elevation and Bird Flight Altitude Combinations Resulting in Exposures above 10 mW/cm^2



The assessment presented here is conservative. The analysis assumes that the birds will be flying directly into the radar beam, which is a worst case scenario. Some of the power densities in Exhibit N-14 are in the near field for the COBRA DANE radar, but were estimated using the far field Equation 2, and thus may overestimate the power densities likely to be encountered by a bird flying through the beam at the altitudes listed. Also, for lower beam elevations and higher bird flight altitudes the time for a bird to fly through the radar beam may be significantly longer than the radar beam would actually stay stationary. For beam elevations between 3 and 10 degrees above horizontal the flight times through the beam range from 40 seconds to 42 minutes. Exhibit N-16 shows the COBRA DANE radar scan area between the heavy lines as well as the high quality tracking area between the lighter lines. From Exhibit N-16, we can see that birds migrating from Alaska along the Pacific Oceanic migration route might fly parallel to the

Exhibit N-16. COBRA DANE Radar Beam Azimuth Coverage Area



radar beam for a portion of their flight. Also birds migrating from Alaska to Asia are likely to be flying more perpendicular to the radar beam than parallel to the beam. Thus the scenario presented above is a worst case, with birds flying only parallel to the radar beam. Migrating birds are more likely to be flying at an angle to the radar beam and thus there would only be a component of their flight that is parallel to the beam.

N.7.1.3 Single Pulse Exposures

This section presents an estimate of risks to birds that encounter a single beam pulse from a radar, and is appropriate to radars operating in the surveillance mode. After each pulse is emitted, the radar "listens" for returning echoes and then changes direction before emitting the next pulse. The chance of the direction change coinciding with the direction the bird is traveling is very small. Thus a bird would not encounter subsequent pulses. This assessment uses the estimates of peak power density at varying distances from the radar in Exhibit N-12. Exposure duration of 10 milliseconds was assumed as the emitted

pulse duration for each BMDS radar. This is a conservative estimate; most radars use pulse widths of 1 millisecond or less in most situations.

Exhibit N-17 shows the results of multiplying the peak power densities at the varying distances from the radar antenna (Exhibit N-12) by 0.010 sec pulse duration and dividing by 360 sec (six minutes). In Exhibit N-17, values less than the no-harm reference value of 10 mW/cm^2 indicate a negligible risk of impacting a bird encountering the beam at the specified distance. Exhibit N-17 indicates that there is negligible risk to individual birds encountering a single pulse of a radar beam.

Exhibit N-17. Peak Power Density (mW/cm^2) Multiplied by Exposure Duration (0.010 seconds) Divided by 360 seconds, with Increasing Distance from the Antenna for Different Types of Radar

Radar Type	Peak kW	Gain (dB)	Peak power density (mW/cm^2) multiplied by 0.010 sec / 360 sec						
			100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	500	53.2	0	0	0	0	0	0	0
C-band	2,500	51.7	8	1	0.3	0.2	0.1	0	0
S-band	2,200	38.6	0.4	0	0	0	0	0	0
L-band	15,500	49.5	0	0	0	0	0	0	0
UHF	582	38.0	0	0	0	0	0	0	0

Note that the values presented in Exhibit N-17 represent conservative estimates, primarily because the far field equation (Equation 2) was used to estimate some of the near field power densities, which will be lower, possibly substantially lower. Second, a 10-millisecond pulse width was assumed, which overestimates pulse width (and therefore exposure duration) for most radars and most situations by an order of magnitude. Based on these conservative assumptions, it can be concluded that none of the radars (when operating in surveillance mode with the direction of the radar beam changing between pulses) are likely to pose a threat to migrating birds.

N.7.1.4 Radars in Surveillance Mode

This section evaluates whether birds flying in the surveillance zone for phased array radars, whose main function is surveillance, namely the PAVE PAWS and COBRA DANE radars, would experience exposures above the threshold of 10 mW/cm^2 averaged over six minutes. The X-band (SBX) radar is not evaluated because it is primarily a tracking radar and not a surveillance radar. The S-band radar is not evaluated because it does not impact birds in tracking operations where the radar beam is stationary, and thus will not impact birds during surveillance operations.

In the surveillance mode of the radar the surveillance zone is covered repetitively, and the surveillance pulses have longer pulse duration than for tracking. The analysis estimates the surveillance zone and beam area in steradians (solid angle measurement) to determine the number of beam positions required to cover the surveillance zone. A bird in the surveillance zone will be exposed to one beam dwell time per surveillance period. Thus the number of times a bird in the surveillance zone is exposed to the beam over a six minute period depends on the time to complete a survey of the entire surveillance zone.

For PAVE PAWS, the surveillance region is 240 degrees in azimuth and 3 to ten degrees in elevation or 0.508 steradians (= 240/360 2π (Sin (10) – Sin (3))). The PAVE PAWS beam width is approximately 0.0011 steradians, so that there are about 438 beam positions to be covered by the two radar faces. For COBRA DANE, the surveillance region is 120 degrees in azimuth and is assumed to be 3 to ten degrees in elevation or 0.254 steradians (= 120/360 2π (Sin (10) – Sin (3))). The assumed COBRA DANE beam width is 0.0003 steradians, so that there are about 835 beam positions to be covered.

The specific revisit time is dependent on the pulse duration assigned to each surveillance pulse. For the PAVE PAWS radar, assuming a pulse-duration of ten milliseconds, the eleven per cent duty time devoted to surveillance, and the use of two radar faces, the 438 beam positions would be covered in about 20 seconds. Thus, a bird flying through the surveillance zone would experience one pulse encounter every 20 seconds or 18 encounters every six minutes. Using similar assumptions for the single faced COBRA DANE radar for pulse duration and duty time, the surveillance zone would be covered in about 76 seconds. Thus, a bird flying through the surveillance zone would experience one pulse encounter every 76 seconds, or five encounters every six minutes.

Exhibit N-18 shows the results of these calculations. The results indicate that birds in the surveillance zones of the L-band or UHF band radars would not be exposed to EMR above the threshold of 10 mW/cm^2 average over six minutes while these radars are in the surveillance mode.

Exhibit N-18. Peak Power Density (mW/cm^2) Multiplied by the Number of Exposures in Six Minutes Divided by 360 seconds, with Increasing Distance from the Antenna for Different Types of Radar

Radar Type	Peak kW	Gain (dB)	Peak power density (mW/cm^2) with distance from radar (m)						
			100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
L-band	15,500	49.5	0.1	0.1	0.1	0.1	0.1	0.3	0.1
UHF	582	38.0	0.01	0.01	0.01	0.01	0.02	0.01	0.00

N.7.2 Risks to Migratory Bird Populations

Sections N.7.1.3 and N.7.1.4 concluded that none of the radars proposed for the BMDS are likely to pose threats to migrating birds while operating in surveillance mode. However, it was not possible to exclude the possibility that a stationary radar beam, as might occur during tracking or calibration operations of the radars, might be hazardous to migrating birds crossing the beam (flying perpendicular to the beam) in the range of 1,400 to 1,700 meters of the COBRA DANE radar. For birds that might fly along the direction of a stationary beam from the COBRA DANE radar at altitudes of less than 1,830 meters (or less than 1,700 meters above the radar), the no-harm reference value might be exceeded. This section evaluates the likelihood that a flock of migrating birds flying by the COBRA DANE radar would be exposed to EMR above the no-harm reference value.

As indicated in Section N.6.1, most bird migration occurs between altitudes of 150 and 1,370 meters, with a majority of migrants flying around 460 meters, except during periods of poor weather when migrants may fly at altitudes of 50 or 100 to 300 meters or so. The calculations in Section N.7.1 indicate that risks of exposure to levels of EMR above the no-harm reference value near the COBRA DANE radar are likely during both good weather and poor weather when migrating birds are flying at lower altitudes. Section N.7.1.2 also showed that during poor weather, and thus lower migration altitudes, that some birds may fly “under” the COBRA DANE radar when its beam is at elevations of 15 degrees or more and not be exposed above the no-harm reference value.

There is unlikely to be population-level impacts on non-endangered bird species. If, however, the majority of migrants were to fly at altitudes of only a few hundred meters, as during periods of poor weather, with many possibly passing directly in front of the radar, and the radar beam is stationary, a majority of birds might be exposed to levels of EMR above the 10 mW/cm^2 reference level. That might have population-level effects on bird species or populations that are in decline.

The estimate of the number of birds that might be exposed to EMR above the no-harm reference value near the COBRA DANE radar are appropriate only to a limited set of conditions and are likely to be overestimates even for those conditions. First, it was assumed that all birds migrate at an altitude less than 500 meters. Second, the reference exposure density, 10 mW/cm^2 (six-minute average), is a conservative estimate of a threshold for possible adverse effects. Finally, this assessment assumes the radar beam is stationary.

For radars in surveillance mode, the sweeping motion of the radar beam may result in all birds flying in the surveillance area of the radar encountering the beam, but the exposure durations in this case are so short that the estimated risk of harm is negligible for all

radars when operating in the surveillance mode (see Exhibits N-16 and N-17 and accompanying text on conservative assumptions).

Thus, risks to migrating birds from radars for the proposed BMDS appear limited to the COBRA DANE radar and are limited to testing conditions when the radar beam might remain stationary for tens of seconds to several minutes (e.g., tracking a test target or during calibration). For the COBRA DANE radar, the risks are only to birds flying at altitudes less than 1,700 meters. None of the radars operating in surveillance mode are expected to pose risks to birds.

N.7.3 Mitigation Measures

The conservative analyses above indicate that the only radar type for which there is some risk in spring and fall to some migrating birds is the COBRA DANE, and the primary concern is for testing with the radar beam held stationary for some period of time (e.g., minutes). To mitigate possible risks to migrating birds, MDA should evaluate the possibility that the COBRA DANE radar might be tested with stationary beams during spring and fall migrations. If so, MDA should evaluate whether the locations where the COBRA DANE radar would be used are in a significant migratory route or near to a migratory stopover, such that large migratory flocks might on occasion pass through the radar beam. If such a risk is deemed to exist, it would then be advisable for MDA to consider use of a local NEXRAD to help evaluate when large flocks might be in the vicinity of the radar so that the timing of a test does not coincide with particularly large flocks of birds flying close to the radar.

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